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ABSTRACT

This publication is a tentative edition of readings on Wildlife and Fish Conservation in Louisiana, and as such it forms part of one of the four units of study designed for an experimental high school course, the "High School Conservation Curriculum Project." The other three units are concerned with Forest Conervation, Soil and Water Conservation, and Mineral Conservation. Each of these units of study is designed to encompass a nine week period of time. This publication includes a teacher's guide section, and sections on the coastal resources of Louisiana, oysters, basic ecology, marsh management of wildlife, the alligator, Louisiana squirrels, rabbits, black bear, white-tailed deer, and wild turkey. Some of the readings have been taken from journals and others appear to have been written especially for this publication. This work was prepared under an ESEA Title III Contract. (BR)

READINGS IN WILDLIFE AND FISH CONSERVATION

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by

Louisiana
Wild Life
and
Fisheries
Commission

HIGH SCHOOL CONSERVATION CURRICULUM PROJECT

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READINGS IN WILDLIFE AND FISH CONSERVATION
LOUISIANA HIGH SCHOOL CONSERVATION CURRICULUM PROJECT

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FOREWORD

This publication is an un-edited tentative writing in Wildlife and Fish Conservation. The materials contained within this tentative publication are printed as they were submitted. With time being a major limiting factor, this material had to be printed without editing in order to place it in the schools before the end of the 1968-69 school year.

The publication is one of four units of study designed for an experimental high school course. The structure of the High School Conservation Curriculum Project (formerly called the Louisiana High School Conservation Course) is composed of units on Forest Conservation, Soil and Water Conservation, Mineral Conservation, and Wildlife and Fish Conservation. Each of these blocks of study is designed to encompass a nine week period of time.

The role of conservation in the school curiculum has primarily a three phase purpose: first, to determine what our natural resources are; second, to determine how to conserve them; third, to establish valid reasons for conserving our natural resources. It is not the purpose of these three phases to act as separate factors but for each to act as reinforcement of the others, thus giving a coherent and integrated program.

In taking the three phases of conservation and treating them as a coherent integrated program, we may say that the overall objectives of conservational ecology are as follows:

1. To illustrate the importance of our natural resources to the social and economic life of the country, the community, and to the individual's immediate environment.
2. To stimulate a desire to help preserve and renew all resources.
3. To keep conservation practices on up-to-date basis.
4. To develop an understanding of the resources problems of present and future generations.
5. To stress that conservation is a serious problem based on scientific principles.
6. To show the very close relationship between conservation and science (both natural and social).
7. To develop the ability of the student to think critically in conservation ecology as well as in other areas.
8. To provide an opportunity to acquire conservation principles, concepts, facts, and attitudes through which the student can better understand the whole of his environment and heredity.
9. To develop the student's ability to acquire conservation information.
10. To develop an understanding that will contribute to the mental and the physical health of the student.

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TEACHER'S GUIDE TO TEACHING CONSERVATION EDUCATION AND NATURAL RESOURCES

by

Dr. Lyle St. Amant

One of the most important problems facing teachers involved in the teaching of conservation education and/or creating public interest in natural resources centers around the fact that there is much confusion and differences of opinion among various groups concerning the real intent and meaning of the word "conservation" and the application of its principles. In all likelihood, most such concerned individuals or organized groups are conscientious in their thinking and are well meaning in arriving at their objectives or aims. Regardless of the intent, however, the aims and objectives between different conservation organizations may be widely divergent and extremely difficult for the young student to understand or reconcile because frequently they are diametrically opposed to one another.

For example, children may be taught by one group to protect the pretty birds, wild flowers and trees at all costs and to leave nature in all its glory untouched; while a second group of equally prominent conservationists may come along and present a picture of harvesting these forestry products, of killing certain game animals and of marketing and creating a considerable industry from various types of fish production. Since each position can be substantiated logically by both groups, it is _extremely important_ that the teacher spend considerable time in explaining any differences and justifying each to the student as a preliminary approach to the teaching of conservation education and natural resources.

Without such an approach, young students may develop incorrect concepts of conservation and the handling of our natural resources which they may retain for the rest of their lives.

Included herein is a rather lengthy definition of the word conservation in all of its connotations. A study of this definition will show immediately why confusion exists between individuals of various interest and why frequently certain conservation organizations interested in birds and animals tend to try to save them for posterity without realizing that they have a limited life span and in one sense of the word cannot be saved. Some of the examples that should be kept in mind in trying to enlighten the students concerning a proper understanding of conservation are as follows:

1. Point out that many birds, animals, and plants live only one year and usually survive through only one breeding season. It is obvious therefore that such living things cannot be saved in one sense of the word, but to be enjoyed must be used, harvested or exploited, when they are available. The only management procedure involved is to see that sufficient seed and/or reproducers survive in order to produce the following year's harvest. Point out, in the case of timber, that virgin stands of timber cannot be saved indefinitely but must be harvested or eventually it will die and be of no use to man. A system of rotation cutting or use of the oldest trees first will give continuous production. Some species of birds, doves in particular, may have a loss of as much as 70% of the population from natural causes each year. Hunting never claims such a toll; but loss from either source does not affect next year's population.

2. Frequently, much propaganda is put out by certain animal and bird

loving societies which tend to indicate that the harvest or killing of animals for sport in some way causes them to become extinct, or much reduced in population. It should be pointed out that such claims never take into consideration that protected song birds and animals which are never hunted or harvested, do not have ever expanding populations. In other words, protected birds do not become more numerous than nonprotected birds and if such a theory were true, the earth should be covered with non-game and protected birds. The reason that hunted and protected populations remain about the same is a well known theory involving the fact that only so many animals can live on a given area of land and that the real controlling factors of a population are the fertility of the land, the size of the area involved and the nature of the environment or habitat on the land.

3. In reality the real controlling factor, of animal and bird populations, is governed by what man does to the animal's environment rather than by what man does to the animal itself. Finally, a sharp distinction should be made between the study of live animals and plants as biological phenomena or as areas of general nature study and the management and harvest of wild game and fish. In the first instance, there is certainly a large area of interest and knowledge developed around pure biology and ecology which deals with living animals and plants as a matter of knowledge and interest and as a part of the environment itself. On the other hand, the management of wild game, birds and fishes is a science and a business involving an important segment of the state's economy. In other words, the function of the Wild Life and Fisheries Commission is not to assist people in Louisiana who are merely interested in protecting birds

and animals; but rather is charged by law to maintain satisfactory hunting and fishing. Furthermore, this responsibility involves a natural resource of considerable economic importance probably exceeding a value to the state of nearly two hundred million dollars a year. The only reason this economic value exists is because the animals and fishes are harvested either for recreational purposes or for food. In this respect, the Louisiana Wild Life and Fisheries Commission is an agency acting in the same capacity as the department of Agriculture or the Forestry Department. It deals with a valuable natural resource and attempts to preserve and furnish this resource to the public for its use. The simplest approach with new students is to teach them that game animals and fish are a crop to be harvested annually just as surely as are cattle, rice or forestry products. It is only through the proper management and harvesting of such crops that this state can reach the full economic use of its natural resources.

Such an approach does not and should not rule out trying to create in the student a natural interest in living things and an appreciation of the beauties of nature. However, such interest should be sharply separated from the wildlife management procedures and should be taught in general courses dealing with biology and ecology rather than termed natural resources.

In final analysis, it is of utmost importance that the young student be clearly made to understand the difference between the various approaches to biology and conservation because, as a future citizen, these same students will have to make judgements as to how their government is to handle the conservation problems of the future.

One of the greatest problems of present conservation specialists is attempting to sell or educate an adult public on proper conservation procedures when they have grown up with ingrained and incorrect ideas concerning the handling of live populations.

(See "Definition of the Word Conservation" on page 6.)

DEFINITION OF THE WORD CONSERVATION

The word conservation is probably one of the most misused and misunderstood words in the English language. This is particularly true because it can be defined or applied to varying conditions in various manners. In general, one should consider the term "conservation" under three general definitions according to the type of thing to be conserved.

Derivation of the word "conservation" comes from the Latin word. CONSERVATE, meaning literally to save; and all to frequently people fail to understand that saving something for posterity and the wise use of a resource, while both can be termed conservation, may require widely different approaches and technical considerations. For example:

1. A wilderness area, scenic wonder, or historic site or building can be conserved or saved for posterity in the strictest sense by keeping it inviolate to change and destruction. This, of course, is conservation in the typical sense that most people use the word.

2. A second type of conservation would involve the judicious use of and careful protection of certain nonreproducable natural resources such as oil, gas, uranium, etc. In this instance, the known reserves are carefully used only for such purposes and in a manner most consistent with the best interest of the public in order that the material will be available for the longest possible period, or until new sources of the material can be found.

3. The term conservation as it applies to game, fish and timber--In this instance these natural resources have the facility to reproduce themselves and to maintain a significant population level. They are also subject to continuous attrition either through natural death or because of utilization by man. In this instance, conservation involves principally the wise use and management of the resources in such a manner that a maximum harvest can be obtained while still maintaining normal reproduction and population densities. Thus, technical management involves attempting to maintain a sustained yield of the product over long periods of time and harvesting the product is an essential part of the management program. In this case, a definition of conservation must include wise use or harvest of this product, since to do otherwise and to allow plants or animals to die without being made available for man's use must be considered wasteful.

The failure of conscientious groups, interested in so-called "conservation efforts," to recognize the three above definitions of conservation, or to support the proper type of conservation for the natural resources within their scope of interest, is probably one of our greatest shortcomings in the field today.

THE COASTAL RESOURCES OF LOUISIANA

by

Dr. Lyle St. Amant

The natural resources of the Louisiana coast are for the most part salt water fishes, crustacea and mollusk but also includes waterfowl and certain furbearing animals. It is important that those of us who live in Louisiana become fully aware of the unique and great value of this interesting and unusual area which is probably the only one of its kind in the entire world. The area which we are going to discuss in some detail lies across the bottom of Louisiana, extending from Mississippi to Texas and averages from 25 miles to 40 miles wide in a north, south direction.

This vast area involves approximately five million acres of marshlands and water where few, if any, trees exist except on higher elevations. For the most part, the area appears to be a vast grassland interlaced with numerous streams and ponds and embayments. The area is about equally divided between land and water. However, when we speak of land in this instance, it is frequently so soft and mushy that one could not stand on it nor could it support buildings or heavy equipment. On the other hand the waters are frequently quite shallow making the area very difficult to travel through or work in. Over all, the area is found to contain brackish water or is a brackish area, which means that it is about one half salt and one half fresh water. This is important as will be discussed later since it has developed into a wide variety of environments suitable for many types of salt water creatures to live in. When one first visits the area the impression is that this vast wilderness of grass, mud and water could be of little value; and there is a tendency on the part of infrequent visitors to never realize that this is probably one of the most valuable areas in the United States.

The production of natural resources, both minerals such as oil, gas and sulphur, and wildlife such as fish, shrimp, oysters, fur, and water fowl, is so great that it staggers the imagination and results in hundreds of millions of dollars being added to the economy of Louisiana each year. Many people realize that the oil, gas and sulphur production of Louisiana is of great economic value but few people know that the commercial fishing industry of Louisiana is a significant segment of the economy equal to or greater than many important agricultural crops. The annual production exceeds nearly one billion pounds of fish products valued at more than one hundred million dollars annually after the first processing and amounting to nearly fifty million dollars annually at the dockside (See Table I.)

* * *

TABLE I

Species	Millions of Pounds Produced	Annual Economic Value
Shrimp	60,000,000 to 80,000,000	$25,500,000
Oysters	10,000,000 to 15,000,000	$5 to $10,000,000*
Crabs	7,000,000 to 10,000,000	$ 1,000,000
Misc. Species	20,000,000	$ 5,000,000
Menhaden	650,000,000 to 1 billion	$10,000,000**
Rough Fish***	150,000,000	$ 3,000,000
Total.....	700,000,000 to 1.1 billion	Net $50,000,000****

* La. oyster production represents 20% total oyster production in U.S.

** Non-food fish converted to fishmeal and fish oils.

*** Rough fish used for catfood, mink food.

**** This represents the net value at the dock; these same fish after the first processing are valued between 60 and 70 million dollars, with the total value of the industry being $100,000,000.

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In addition to the exceedingly high fishery production, the fur production of Louisiana has always been greater than any other state in the union, and in some instances has exceeded the production of all states combined. Even during lean years which have occurred recently, we find that Louisiana produces some 350,000 to 8 million muskrat pelts, 1.3 million nutria pelts, more than 50,000 mink furs and some 8 to 10 thousand otter furs.

It seems incredible that the vast production along our coast makes Louisiana rank first in the production of shrimp, oysters, fur and menhaden in the United States. Many of our fish, though ranking at lower levels, are practically unexploited and it is believed that the crab fishery and fin fish production could be boosted in rank to equal any other area.

In final analysis, the fishery production along Louisiana's coast is indeed unique and extremely high, and for the most part, furnishes a larger percentage of the total fishery of the northern Gulf of Mexico. This is important because the vast marsh areas of Louisiana actually serve as a nursery ground for much of the Continental Shelf and the waters of neighboring states. All together the northern Gulf produces 31% of all of the fish poundage taken from the United States waters, and this production, because of its great value of fine food fishes, represents some 35% to 40% of the total fishery value of the United States.

In conclusion, the coastal fishing industry of Louisiana supports from 15 to 20 thousand active fishermen and their families and involves some six to ten thousand fishing vessels. In addition, numerous supporting industries such as ice companies, shipyards, fuel companies, net factories and canneries depend on this industry as their principal source of livelihood.

THE NATURE OF LOUISIANA'S COASTAL AREAS

by

Dr. Lyle St. Amant

In the preceding section we have discussed the great production and extreme value of the natural resources on and associated with the Louisiana Coast. It should be obvious that an observing student will want to know why this great production of fishes occurs along the Louisiana coast and fails to occur in other coastal areas of the United States or the world. This is indeed an important question, and one which scientific people have examined carefully over the years. After considerable study, it now becomes apparent that the Coast of Louisiana is different from most areas because of its association with the great Mississippi River and its outpouring of sediment and fertile nutrients that have washed from the surface of over half of the United States. This segment under discussion will deal principally with the geological background of the formation of the coast and the type of environment which has evolved in the area. This is an important segment of study because a clear understanding of the important role of the environment in the protection of natural resources will greatly aid the student in a direct appreciation and concept of conservative practices and procedures.

The Louisiana Coast is different from any other area in the world because it was built thousands of years ago by the wanderings and action of the Mississippi River Delta. The mouth of the Mississippi, or the delta, has not always been at its present location southeast of New Orleans; but over the past fifteen to thirty thousand years has moved or wandered from the Mississippi line in the area it presently occupies by Lake Pontchartrain and Lake Borgne to as far west as the Mermentau River in western Louisiana. This wandering and moving of the mouth of the Mississippi has built up vast areas of marsh, has resulted in large and small embayments, and has produced extremely fertile and rich areas along the coast that now act as a vast nursery ground for practically all of the fishes on the adjacent Continental Shelf.

HOW MARSHES ARE BUILT --- Figures I & II, pages 23 & 25, will illustrate first the present delta of the Mississippi River and then a diagramatic sketch of a delta formation. Note that the distributaries (see definition) of the delta always diverge at approximately a 45° angle. This occurs because at any other angle sedimentation results and the distributaries rapidly silt up. An examination of a cross section of one of the distributaries (See figure II) shows how natural levees are built up and how adjacent and lateral areas become silted and form marshlands. During low water periods the entire flow of water is contained within a distributary channel and carries the relatively moderate to low silt load. During flood stage, excessive silt is moved down and the water exceeds the size of the channel and overflows the edges of the distributary or stream. When this occurs, current direction and velocity are suddenly changed and reduced and the silt load is deposited on each side of the natural channel. This results in the formation of a natural levee deposit. With each succeeding flood of the area, the natural levees grow higher and broader and the area behind or adjacent to the natural levee forms marshlands and drowned areas. (Study the segment of diagrams in Figure II carefully.) The final result is generally a strip of high land on each side of the distributary as it approaches the Gulf behind which is a marshy or swampy area which gradually slopes and subsides down into a permanent wet area or embayment. As one travels through the coast of Louisiana, most of the roads and the houses are built along the old natural levees and careful observation will show that to the rear and away from this high land area, one will notice the marsh or wet land. As the Gulf is approached, the high land becomes narrower and narrower and the marsh and water encroach to the very roadside. In this way, marshes were formed over the recent geologic history of the area.

WHY AND HOW DELTAS MOVE --- One might question whether such a vast area as the present Louisiana delta could ever move a significant distance in order to form a similar marshy area in some other segment of the coast. Surprisingly this can occur and would have occurred in recent years had not the United States Corps of Engineers made an extreme effort to prevent the Mississippi River from developing a new channel and new delta through the Atchafalaya system allowing the present delta to become secondary, shallow and silted up. It is believed that new deltas may be formed by water attempting to find the shortest route and path of least resistance to the ocean. Frequently, wave action and silting at the mouth of the distributaries during low water periods will tend to dam up large segments of old active deltas. This has been prevented over the years in parts of the present delta by the use of jettys designed by the Corps of Engineers to keep the channels open. After a considerable low water period and when the mouths of the distributaries have become heavily silted, sudden high water periods will find the flow impeded and the water will tend to break out further up stream forming a new and shorter path to the Gulf. This occurred before man's attempt to control the River in the form of crevasse flooding and the formation of new channels such as the Atchafalaya system. In this manner the Delta of the Mississippi River has wandered over the years throughout the coast building marshlands, forming numerous distributaries, embayments and drainage patterns.

IMPORTANCE OF A NATURAL DRAINAGE PATTERN IN MARSHES --- Actually, the drainage pattern which has developed in the marsh through deltaic action is the key to the marsh environment and is basically the reason in addition to fertility which has resulted in the extreme production along Louisiana Coast. Examine Fig. III, page 27, carefully. You will note that drainage is from north to south following old meandering distributaries and bayous which empty into embayments and ponds throughout the marsh area and then travel to the Gulf through relatively narrow passes between barrier islands along the seabeach. The result of this pattern is that fresh water from rainfall and river drainage from the north flow into the area carrying vast amounts of nutriment and sediment where they meet and mix with the salty water of the Gulf entering through the passes from the south with tidal exchanges. These waters tend to meet and mix in the embayments which are generally shallow and where mixing occurs mainly by wind action. When this occurs, a gradual transit, from fresh to salt water, occurs in 30 to 40 miles of marsh, and as one proceeds from the high land to the Gulf, the waters gradually become saltier and saltier. Because of this, the coastal area may be arbitrarily divided into zones or regions starting at the Gulf and moving toward high land with each region having a characteristic salt content or salinity (See Fig. III, page 27). This is important because this variation in salinities affords the various animals a choice of environment which suits them best.

SEA WATER, BRACKISH WATER, AND FRESH WATER --- In order to understand the nature of marine animals and their reaction to the environment, it is necessary to know what is sea water and what is fresh water and what happens when they mix. Pure salt water contains a relatively constant amount of salt which is approximately 36 parts per thousand throughout most of the oceans of the world. This means that for every thousand pounds of water, there is dissolved in it approximately 36 pounds of salt, most of which is common table salt or sodium chloride. In addition to common salt, numerous other chemical salts also occur in sea water in small but important amounts. For a better example, it is suggested that the student weigh a given amount of water, approximately one quart or one meter, and then add table salt in the ratio of 36 parts for every 1000 parts of water. This should give some idea of the volume of salt in sea water.

Certain areas in the world have greater amounts of salt such as the Dead Sea, Great Salt Lake, and the Laguna Madre in Texas. These areas exceed natural salt content, mainly because they do not receive adequate circulation or drainage from fresh water areas and evaporation causes the salt content to increase. Such areas are few however and more frequently the reverse occurs whereby fresh water pours into the salt water areas from rivers and drainage basins and we find a mixing of fresh and salt water. In most instances where mixing occurs thoroughly, a direct arithmetical ratio is the result. That is, if fresh water which has zero salt is mixed, half and half with sea water having 36 parts per 1000 salt, the resulting mixture will be 50% seawater and contain 18 parts per thousand

of salt. Obviously, as fresh water moving into the salt area over vast areas such as the Louisiana marsh, a scale of saltiness develops, (See Figure III) within which one may find areas ranging from fresh water to sea water and all stages in between.

Before concluding our observation on the nature of the salinities of waters, one important factor should be observed. This is that the salinity at any position in the environment may change or fluctuate rapidly depending on the amount of rainfall, the inflow of fresh water, or the inflow of salt water resulting from high tide or wind action. This means that from year to year, or month to month, that the environmental zones developed within the nursery ground may shift position and over periods of time, one may have what is considered a dry or extremely salty environment or a wet and relatively fresh environment. Such fluctuations of the salt content can greatly affect the animals within the area and the density of their population from time to time. This will be more fully discussed, when specific animals are studied.

IMPORTANCE OF TEMPERATURE---In considering the effects of the environment upon the various animals in it, both water and air temperature fluctuations become extremely important. This is especially true when we consider fishery management problems because it must be remembered that fish and related forms are coldblooded animals and react directly to temperature changes. For example a coldblooded animal's metabolism (See definition.) directly corresponds to the temperature of its immediate environment. Thus, when temperatures are high the metabolism is rapid and all bodily functions speed up. Conversely, when temperatures are low, metabolism is low and bodily functions slow down--in some cases resulting in periods of dormancy,

or hibernation. If the animal does not tend to hibernate at low temperatures, then we may expect it to migrate to offshore deep waters to remain warm throughout the colder periods of the year. For the most part, water temperatures parallel air temperatures becoming colder as air temperatures drop and warming up as the air temperature increases. This parallel is particularly noticeable in shallow waters of less than 25 feet in depth. In deep, large bodies of water, the effective air temperature is less noticeable and is only apparent in a few feet near the surface to the bottom and once depths of 100 feet are exceeded, water temperatures are comparatively stable varying only a few degrees between winter and summer.

In the shallow water of the estuary or nursery ground, temperature plays a very important part because it varies markedly between summer and winter conditions. If one plots the water temperature at a given point against time in months, a typical curve may be expected (See figure IV). This graph demonstrates diagramatically that water temperatures will be low in the winter months gradually rising to summer conditions in mid or late spring and remaining at high levels until the cool air masses begin to move through the state in late November. An examination of the graph will show that the line of demarcation between winter and summer conditions is a temperature of 20° Centigrade 68° Fahrenheit. This point in the temperature curve has been established through many observations on various types of fish and crustacea in the estuaries. Generally speaking, when temperatures are below 20° many of the animals are inactive because of low metabolic rates. They tend to feed infrequently, they do not breed and in some instances they may hibernate and become dormant. Other species such as the shrimp and certain fishes leave the shallow water in winter periods and move offshore in deep, relatively warm water. Therefore, in the wintertime we see little activity in the estuary.

When summer conditions occur, at temperatures above 20° Centigrade, an amazing transition takes place in the estuary or shallow water area. We immediately see increased activity and migration of animals into the area. Breeding begins to occur and in a short period of time, the water is swarming with larva forms of the various species. Feeding increases, which results in noticeable increase in growth rate.

The statements made thus far concerning temperatures would naturally be expected when one considers the difference between summer and winter on coldblooded animals. One factor, however, which is frequently missed by some observers is that the date on which the transition from winter to summer occurs may vary considerably from year to year. A reexamination of Figure IV will show that in mild, dry winters, summer conditions may arrive as early as the 12th week of the year. Conversely, in extremely cold winters, and late spring conditions winter water temperatures may continue in the embayments as late as the eighteenth week of the year. It is important to note that the start of summer conditions in shallow waters may vary as much as six weeks from year to year and as much as three weeks from the average expected conditions. Such a variation markedly affects the arrival and growth rate of all the animals in the nursery grounds and, particularly, the growth of shrimp and the breeding periods of oysters. Because of this, temperature becomes an important factor in determining the proper time to open seasons for harvesting and in determining the size and nature of the population to be expected. This point will be emphasized considerably in the discussion on shrimp in the next section.

TIDES AND TIDAL EFFECTS---One can hardly be expected to talk about oceans and salt water without discussing the phenomenon of tides and tidal cycles. Most students are well aware of the rise and fall of the tides and its association with the position and effect of the moon. There are many other factors about tides however which the average student will not be familiar with. For example, tidal activities tend to originate at the poles of the earth and move toward the equator and tides tend to be high and are greater in the northern latitudes than they are in equatorial areas. In most areas along the continental edges two tidal changes occur each day; that is two high tides and two low tides occur alternately every six hours. In certain embayments or semi-enclosed areas such as the Gulf of Mexico and the Caribbean Sea, only one tidal cycle occurs per day. That is, one high tide and one low tide twelve hours apart.

The height of the tide varies greatly around the world. In certain areas like the Bay of Fundy, extreme tides may occur, in some instances reaching fifty to seventy feet. More normal areas in temperate zones may find tides ranging from 3 to 8 feet and they become smaller and smaller as one approaches the tropics. For example, on our Gulf Coast the Lunar tide is in one sense negligible since it is barely more than plus and minus one foot (See diagram). Along the Gulf Coast, high tides are generally associated with wind and are generated by strong or moderate south and southeast winds blowing toward shore for long periods of time. Wind tides on the Gulf Coast do not follow a Lunar Cycle but tend to be superimposed on the Lunar Cycle. Wind tides may reach plus or minus three feet and hurricane tides may reach heights of eight to twelve feet.

INSTABILITY OF THE COASTAL AREA AND THE PROBLEMS OF MANMADE CHANGES----

Concluding this section on the basic geology and environment of the estuaries and coastal areas of Louisiana, certain important factors should be kept in mind. First, the geological history of the Louisiana coast is considered to be very recent and probably less than 25,000 years old. Factually speaking, the area is still in a period of geological formation and has not yet reached its final state or reasonably stabilized condition. Man has more or less harnessed the delta of the Mississippi River and its building action in order to prevent drastic floods. Had this not been done, the delta may have continued to build the coast of Louisiana for many years to come. Second, since the River has been more or less harnessed, the coastal area is attempting to stabilize and because of this is rapidly changing. Because of its instability it can be readily changed by catastropic weather conditions or by man himself. Generally speaking, the natural trend is for the area to sink and subside, for more salt water to move into the marsh area; in time the result will be wider expanses of water and larger embayments.

Man's activity within this unstable area tends to greatly hasten such changes and frequently to cause serious destruction to important nursery grounds. For example canals and dredging tend to change direction of currents, to change current velocity and to result in extreme changes in salinities. Silting of areas may occur either directly or indirectly from man's activities and because a natural drainage pattern was markedly disturbed. Frequently dredging activities and the placement of levees and spoil banks tend to disrupt navigation and the free passage of movement of the fish.

In final analysis, man's activity in this highly unstable marsh area is the greatest single danger to the environment and to the continued production of an excellent fishery.

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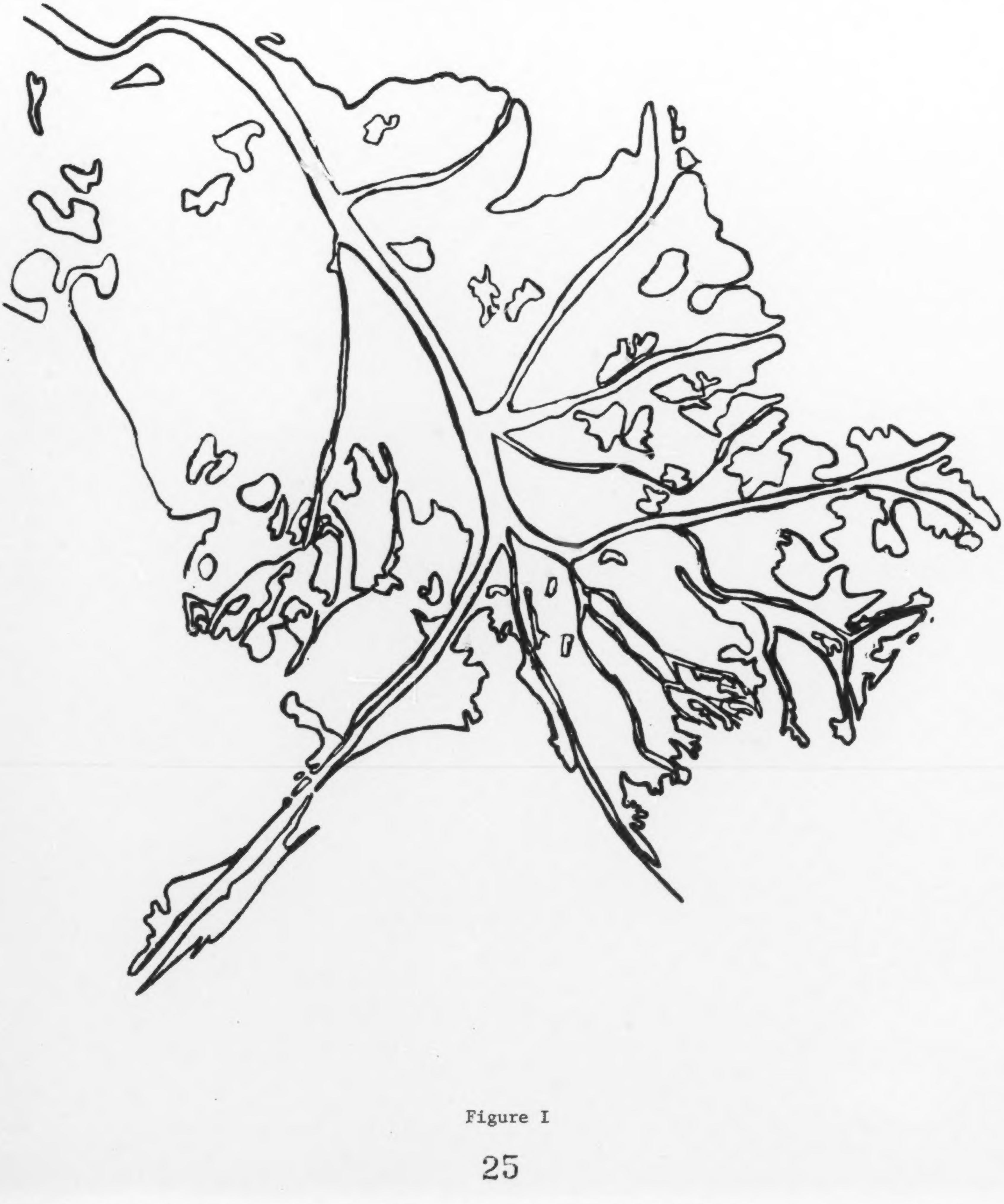

Figure I

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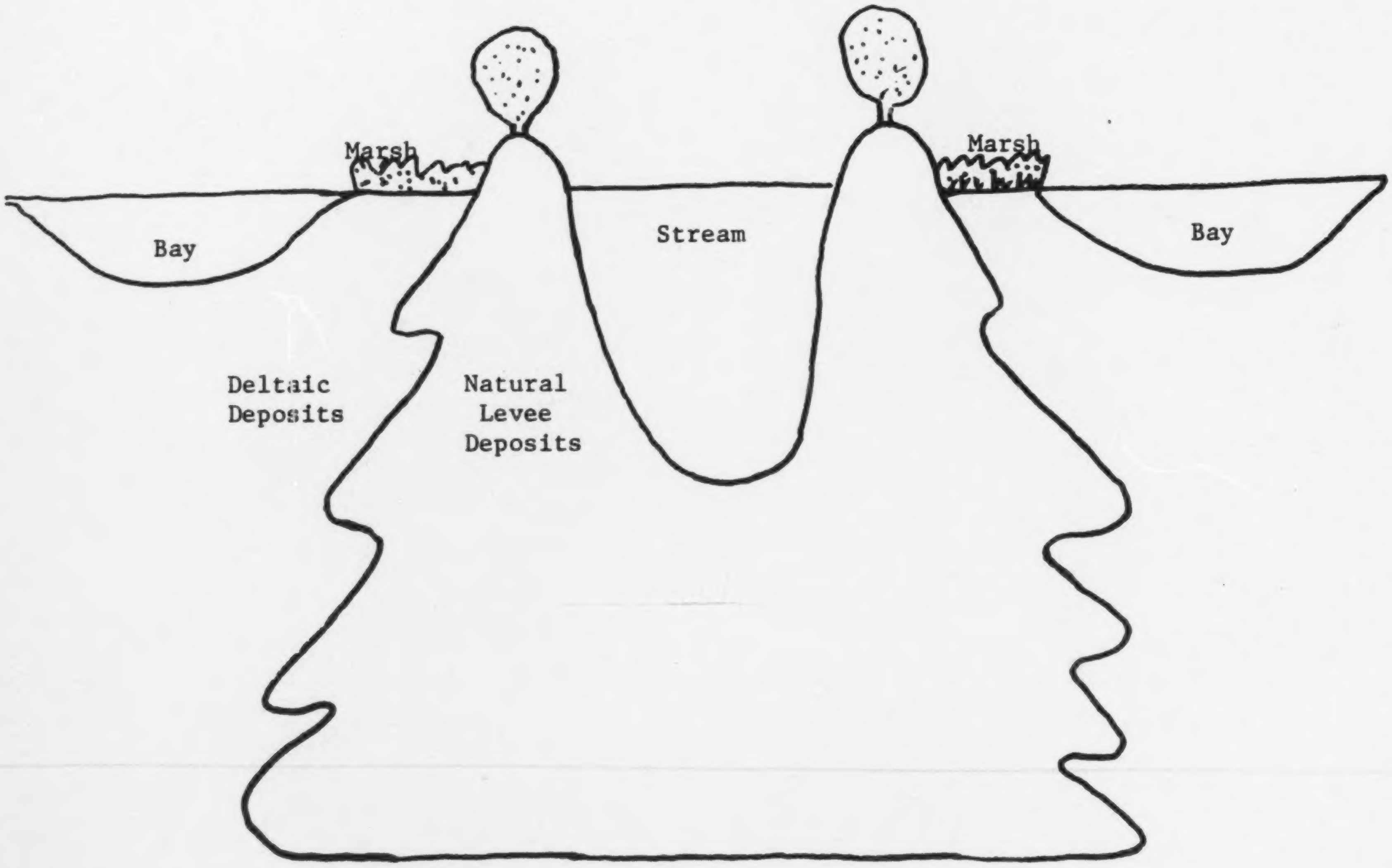

Figure II

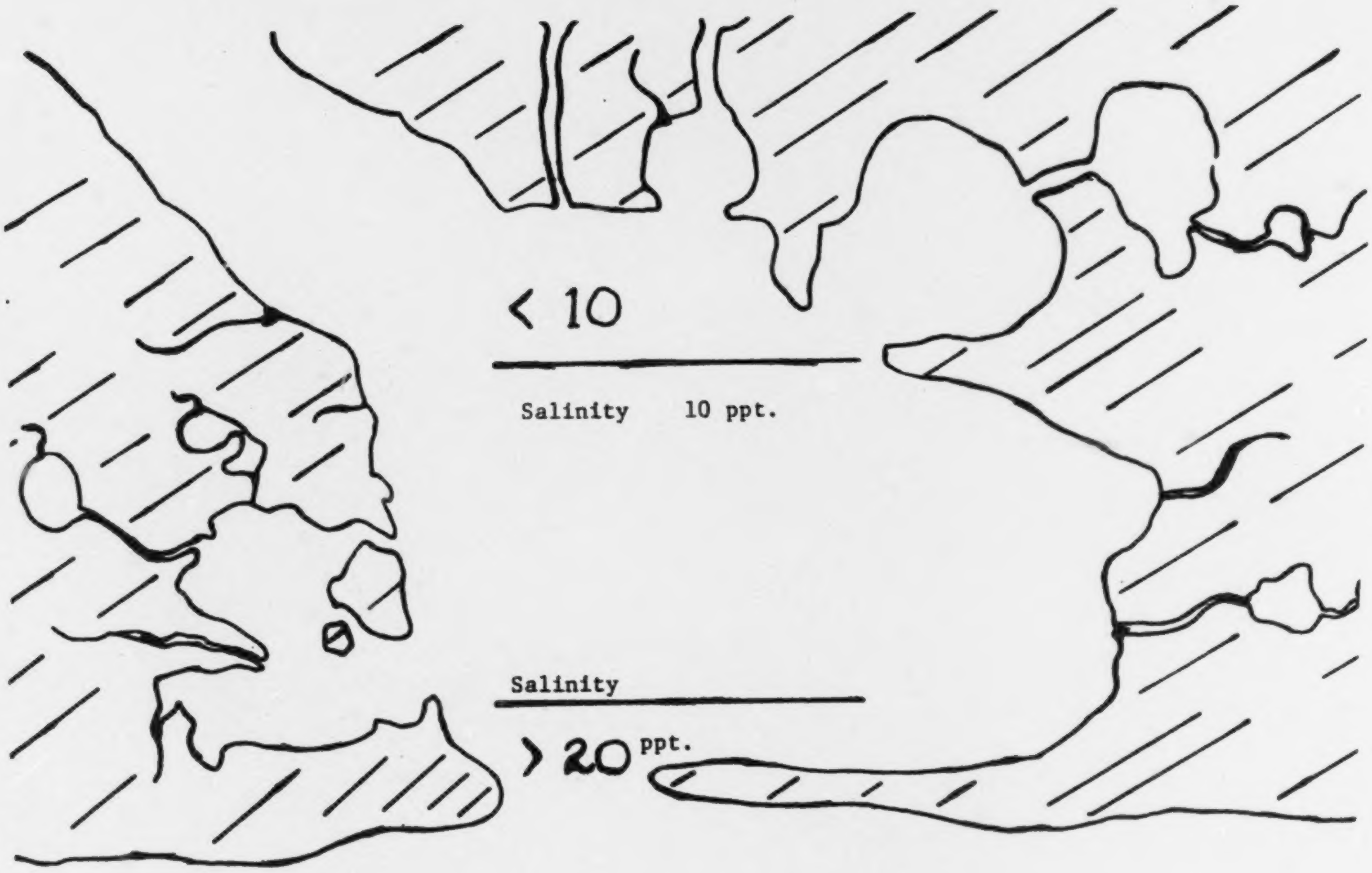

Figure III

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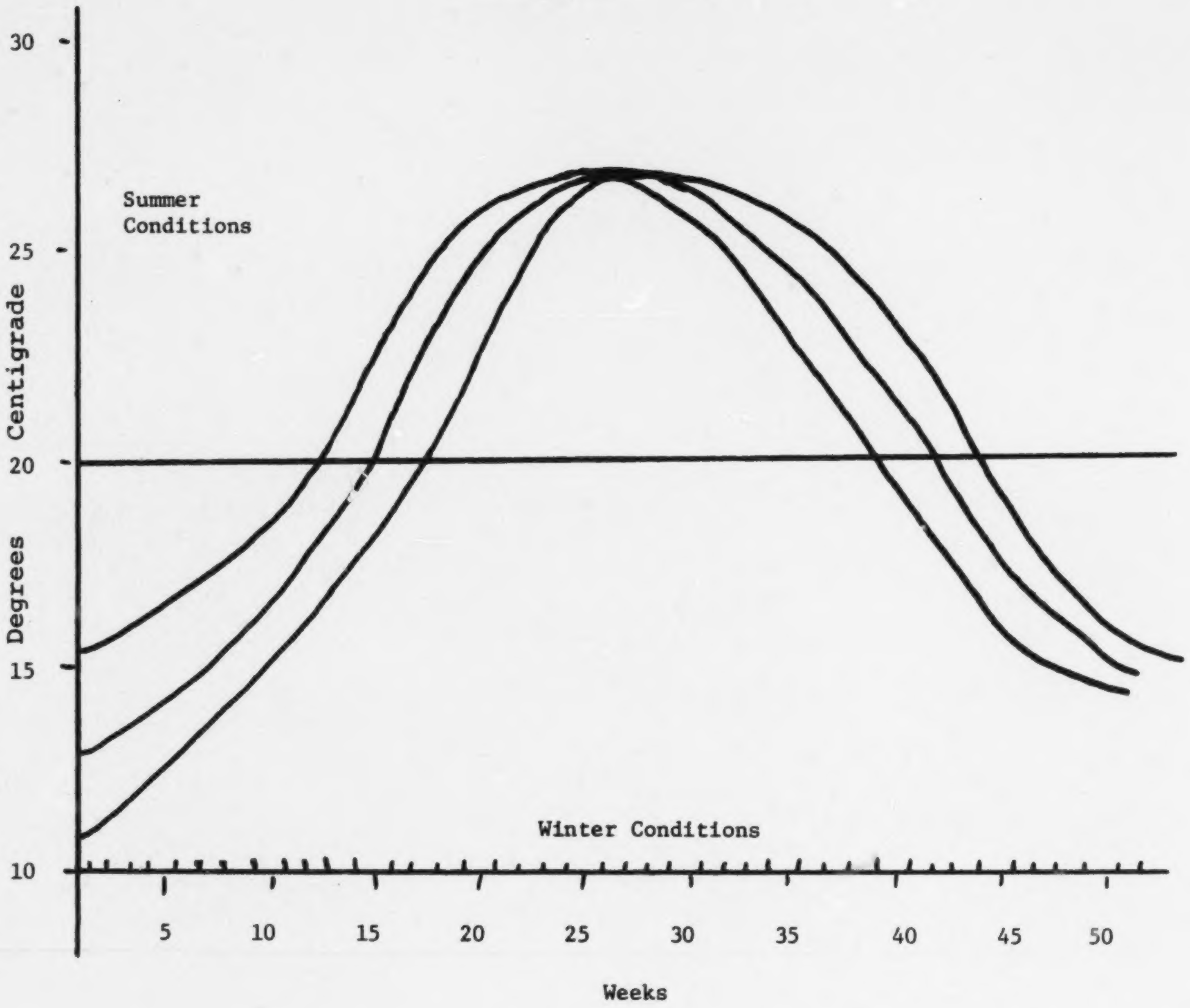

Figure IV

OYSTERS

By

Dr. Lyle St. Amant

Anyone who has studied the sea and its living inhabitants is well aware that thousands and hundreds of thousands of animals and fish inhabit this environment. A study of Marine Biology attempts to encompass and evaluate biologically as many of the species as possible; but even within the scope of Marine Biology much specialzation is necessary in order to develop detailed knowledge of a few species.

In approaching the subject of the management of marine fishes within the estuary, several points should be kept in mind. Mainly, because of the cost of obtaining technical data and working in the marine area, only those fishes of economic importance can be studied in great detail. Furthermore, state and federal funds for the most part are directed at studies on and concerned with those species directly sold and used as food. Studies of related animals are made when they are involved as an important part of the animal's life cycle, food chain and environment. It is obvious that a detailed discussion of all important marine species cannot be undertaken at this level. However, a discussion of two of the important species is offered since they are wellknown and demonstrate clearly the value and the nature of proper research and management.

The two species to be discussed are the oyster and the shrimp. It is interesting that one, the oyster, has probably been studied longer, cultivated longer, and is better known than any other creature in the sea; and on the other hand, the shrimp though known for some time, has only recently been studied in great detail and represents some of the newest knowledge in Marine Biology and fishery management.

It is most interesting to note that the oyster has been under cultivation as a crop, and considered a delicacy by man since the time of Christ. Two thousand years ago the Romans had oyster beds under cultivation, wrote about methods of cultivation and shipped oysters to Rome packed in snow. Since the oyster was well known and does not move about, it became one of the first animals to be studied by the marine biologist. The result has been voluminous publication concerning the oyster, so much so that one would think that there is little work left to be done. This, however, is not exactly the case. Oysters are creatures very sensitive to their environment, and in order to properly manage and cultivate them, it is necessary that the animal be studied in each separate and different environmental niche. For example, oysters react differently east and west of the Mississippi River and they also react differently in waters of different salinity. Because of this, working with oysters within any area really evolves into an intensive study of the local environment, i.e., water temperatures, varying salinity, available foods, type of bottom, etc., so that a management procedure can be developed for each local area.

LIFE SPAN AND GROWTH RATE OF OYSTERS---Many people imagine that the oyster is a long lived animal. This is not necessarily true. Some oysters may live ten to twelve years, but in most cases rarely reach three years. The average age of an oyster on the market is usually two to two and one half years. Even though, the oyster not only must grow its soft body part, but also produce a rather bulky calcium carbonate shell. Growth rates under optimum conditions can be extremely rapid. Oysters have been observed to grow from a microscopic larvae to five inches in length in as little as eleven months. The average growth rate is about three inches during the first year of life.

BIOLOGICAL CHARACTERISTICS OF THE OYSTERS

By any standard of observation, the oyster is truly a peculiar animal. It belongs to the phylum mullusca and is a close relative to clams, snails and the octopus. One important characteristic that separates the oyster from all other mollusks is its sessile nature. This means that the animal does not move and has no method of locomotion; in fact, is actually cemented to some hard object on the bottom and is unable to move. Because of this sessile characteristic, the oyster has gone through a period of regressive evolution in which many of the normal organs have been lost. For example, the oyster has no head, no eye, no feet, no hearing organ and no method of locomotion. In fact, one might even wonder what an oyster does have in the way of biological organs. Obviously, since this is a live animal, it contains the organs essential to life and reproduction. An oyster has a well developed digestive system, a complex reproductive system, gills which are necessary to transport oxygen to the tissues, a rather complex circulatory system and one major muscle used to close the shell.

Since an oyster is unable to move about in search of food, one of the interesting biological phenomena associated with the animal is its method of feeding. Actually, the food must come to the oyster rather than the oyster searching for the food. Oysters obtain food by filtering microscopic plants and animals known as plankton from the surrounding waters.

In order to successfully feed and grow, an oyster must pump and filter as much as one hundred gallons of water per day. (Note: One acre of oysters may contain some 300,000 to one half million oysters. Students should calculate the volume of water pumped by the oysters on a large oyster bed in one day. Note that volume required probably exceeds the amount of water over the area.) Since so great a volume of water is necessary to adequately supply food to an oyster bed, it becomes obvious that oysters can survive only in areas where a substantial flow of large volumes of water occur over the bed. In addition to great volumes of water rich in food, proper salinities and water temperatures are also important in the establishment of an oyster bed or reef. These environmental factors in all probability control the location and size of oyster beds along the coast.

LIFE CYCLE-- Oysters are protandrous. This means that they can change sex from male to female and vice versa. The American oysters are born males and after one year of life change to females when the ratio becomes 90% females and 10% males. Generly speaking, they remain females the rest of their life however they may revert to males during old age if they live long enough. The European oyster on the other hand, changes sex each year. The sex organs of the oyster are to a large extent activated by water temperature. During winter conditions when water temperatures are below 70° Fahrenheit, the gonads of oysters are inactive, small and undeveloped. As the water temperature rises in late spring, gonadal development rapidly occurs with the female oyster producing upward to 300,000,000 eggs by the time of spawning. The large ovary, generally white in color, makes up a considerable portion of the body mass in the early summer months, and it is at this time that oysters are said to be milky. The peak spawning period usually occurs during the months of May or June. However, in the warm water of the Gulf, some spawning may occur throughout the year and in certain areas, a fall spawning peak occurs in September and October. The mechanics of spawning is brought about by certain conditions of tide, temperature and apparently salinity. The male spawns first and releases his sperm into the surrounding water. Apparently chemicals associated with the sperm trigger or cause the female to spawn and release upward of two to three hundred million eggs. Fertilization occurs almost immediately while the eggs are floating in the water and development is rapid. Within a few hours, numerous cell divisions have occurred and a resulting ball of ciliated cells begin to swim or move about in the water. This tiny oyster larva then remains free swimming and rapidly develops two small shells and an internal soft body structure. It is free swimming in the water for a period of ten to fifteen days, depending on water temperatures, after which the shell becomes too heavy to support and the tiny animal settles to the bottom to set where it remains for the rest of its life unless moved by man. It is obvious that should all the fertilized eggs of oysters develop into adults, the oceans would be full of oysters. It has been calculated that the breeding potential of oysters is so great that within a few years, should all the young survive, all of the oceans of the earth would be filled to capacity with oysters. The volume of larval oysters, however, is nature's way of insuring the survival of the species because at the time of setting most of the young oysters fail to survive since they settle into the mud of the bottom and are smothered. Only those tiny oysters that are able to find a hard substance such as another oyster shell or stone or some object to attach themselves to which will keep it elevated above the silt and mud survive the setting period. In all probability, only a fraction of a percent of the fertilized eggs survive this ordeal. Once oysters set, growth is extremely rapid during the first three or four months and the microscopic oyster within the first two or three weeks may be as large as a dime and after three or four months, may be two inches or more in diameter. It is during this period, while the oysters are young and the shell is thin, that they are most vulnerable to predators and predation from snails.

THE NATURE OF THE OYSTER INDUSTRY AND ITS PROBLEMS

by

Dr. Lyle St. Amant

The oyster industry in Louisiana, as in much of the United States, is based on the fact that oysters may be cultivated as a crop similar to the way agriculturists handle cattle and other living creatures. In other words, under certain conditions of overcrowding, excessive breeding and poor feeding conditions, oysters may not do well or survive at all. Conversely, under optimum environmental conditions, with good food, right water temperatures and salinity and low predation, oysters grow rapidly and produce extremely well.

The secret to properly handling oysters, of course, is to determine their reaction to their environment and to plant them in areas of optimum growth. This appears to be simple; however, it becomes quite complex when we find that no single place offers a set of optimum conditions for growth at all times. For example, in Louisiana oysters grow well, fatten rapidly and reach a choice quality if not overcrowded, when planted in areas of relatively high salinity (above 15 parts per thousand.) But in such areas, other problems arise. The common Oyster Drill, or Snail, which can bore through the shell of an oyster and eat it, is a high salinity animal and frequently oyster beds are literally devoured by these predators in highly saline areas. In addition to the snail, fungus diseases, sponges, boring clams and other types of pests tend to reduce oyster production here. Therefore, it can be said that most oysters in Louisiana cannot complete their life cycle with any degree of reliability in waters which exceed 15 parts per thousand salinity.

On the other hand, in low salinity areas, ranging between 5 parts to 15 parts per thousand, oysters are able to survive indefinitely, to breed, reproduce in great quantities and grow satisfactorily. While growing oysters in these areas are not generally considered choice, because they are overcrowded, unsalty, and of poor quality, they do survive, however, because diseases are generally absent and predation from snails and other animals is at a very low level. With these two types of areas existing in Louisiana, the oyster grower is able to so manipulate the oysters as to actually cultivate them into a higher quality product. Wild oysters are grown on state-owned seed grounds in low salinity areas, in most parts east of the Mississippi River. These areas are managed by the state and are opened annually to fishing from September 1 to May 20. The oyster industry harvests oysters from this area, transports them to privately leased waterbottoms and replants them. Generally the leases are located in areas of high salinity and where an exceptional quantity of oyster food has been demonstrated to occur in the water. In replanting the oysters are culled, separated and planted in a definite pattern to prevent overcrowding. Planting occurs from September to November, growth is rapid, and generally they are harvested before the next summer. Predation and disease in high salinity areas are not a problem in the winter since most predators and diseases are inactive or relatively dormant during the cold weather periods. Should the oysters be left in the area throughout the following summer, extreme mortalities may occur.

The handling of oysters can be well compared to the way free ranging cattle are moved from one area to a feeding lot or a fertile pasture in order to prepare them for market. Essentially the same thing is done to the oyster by the oyster grower. In Louisiana, the oyster industry is a private enterprise. While oysters do grow wild and are managed by the state, the final oyster production occurs on privately leased waterbottoms which the oyster fisherman leases from the State of Louisiana at the rate of one dollar per acre per year. These areas are selected by the oysterman, surveyed by the State, and granted on long term leases. By carefully breeding and rebreeding; by protection from predators; and by learning at what time of the year oysters are in prime condition, a Louisiana oysterman does produce a high quality product.

The oyster is usually marketed in three general categories: namely, canned or cooked oysters; raw shop or shucked oysters found in stores; and as sack oysters in the shell which are sold to restaurants and oyster bars. All three phases of the industry are quite important.

MAJOR PROBLEMS OF THE OYSTER INDUSTRY - The growth and cultivation of oysters though simply stated above is not always a bed of roses, and certainly requires extremely hard work; and the fisherman is frequently faced with other problems affecting his industry. Some of the major problems in the oyster business are pollution; the effect of man's industries operating in an oyster area; oyster diseases; and predation which has already been mentioned.

POLLUTION: Pollution in oyster areas can be quite troublesome and in some industries may result in the condemnation of entire oyster beds or oyster growing areas. Pollution falls in several categories. It may involve bacterial pollution, not harmful to the oyster but which may cause diseases in man such as typhoid fever or hepatitis. Some types of pollution from chemical industrial plants and/or pesticide residues may result in the wholesale killing of oyster beds. Others may only result in the oysters being made unfit for human consumption either because they are unpalatable from an obnoxious odor or taste, or may be poisonous to human beings.

The pollution factor is compounded by the fact that oysters pump and strain so many gallons of wate[illegible]er day. Very low levels of pollution in the water proper may result in high levels occurring in the oyster proper. For example, oil or pesticides occurringin water as low as one part per million, which might be considered an acceptable level and unnoticeable, can be picked up by oysters and concentrate 25,000 parts per million in a week or two. Such high levels of foreign substances in oyster leases may make the oysters unfit for human consumption and subject to contamination. The same is true with respect to unwanted bacteria in oyster waters. Low levels may concentrate to dangerous levels within oyster meat. Luckily, however, oysters can be cleared of such pollution if they are placed in clean water and allowed to pump themselves clean for a period of several weeks. This operation is known as depuration.

Aside from pollution, man's industrial operation in oyster areas has other serious effects on the industry. In Louisiana, in particular, the establishment of oil wells, tank battures and the dredging of canals and navigation channels have resulted in destruction and damage to oyster areas. Usually the damage occurs two ways: the direct damage of dredging up the oysters or oyster beds proper or the silting over of beds by drifting spoil. Indirect effects may occur when levees or canals are cut and change the entire environmental picture of the area which, as a result, changes the salinities, waterflow and causes widespread redisposition of bottom sediments. One of the principal jobs of the Oyster Section of the Louisiana Wild Life and Fisheries Commission is to maintain the proper protection of oysters from such activities and to make studies of the effects of man's operations on the oyster areas.

OYSTER DISEASES: Marine animals like all living creatures are subject to natural death from diseases and other causes. Oysters are no exception to this rule. Various types of parasitic diseases occur in oysters, but the one in Louisiana which causes the most problems is a fungus which attacks oysters in their second year of life and in areas of high salinity in extremely warm temperatures. This fungus, known as Dermacystidium marinum, nearly decimated the oyster industry in the 1940's and resulted in changed methods of harvesting and handling to avoid the growing of oysters in high salinity areas during warm summer months. On the East Coast, a disease known as MSX, also a type of fungus or virus, has caused great damage to oysters in the Chesapeake Bay Area. Other types of diseases are usually parasites or bacteria which invade the oyster tissues and eventually result in death. There is no simple way to control oyster diseases; however, they are usually less active, or inactive, during winter months and not so prevalent in areas of low salinity. Thus, by moving oysters from one area to another to avoid such disease problems, the oyster farmer is able to maintain satisfactory production.

PREDATION: Numerous types of animals prey on oysters. This might seem surprising since the oyster has a rather rugged shell to enclose and protect itself in. Yet several types of animals are capable of either crushing or entering the oyster shell in order to kill and feed upon its soft body part. The common Oyster Drill or Snail is able to bore a hole through the shell and feed on the oyster. They are particularly effective in destroying small young thin shelled oysters. The Stone Crab can crush an oyster shell and the Common Blue Crab is capable of nibbling away at the edge of the oyster shell until it destroys an oyster. The common Drum Fish can take a whole oyster within its mouth and crush it, or on the East Coast, the Starfish is able to hold an oyster, evert its stomach, open the oyster and literally digest the oyster within its own shell.

Predation is not easily controlled. Generally speaking, rotation of oyster beds or the trapping of predators has been the principal approach to avoiding excessive predation.

SOME OYSTER FOLK TALES---Few people who have eaten oysters have failed to run across some of the common folk tales associated with this animal. The more common one concerns the fact that oysters are inedible during the months of the year without an "r", or that oysters cannot be mixed with milk or with alcohol. Actually, all of these are folk tales and have no basis in fact. Oysters are frequently cooked in milk and some of the finest oyster stews contain milk. The only problem here is that both milk and oysters are exceptionally good bacteria media and both should be fresh or refrigerated until time of use. Should they be mishandled or allowed to become contaminated with bacteria, they can make you quite sick. The same general facts apply to alcohol. It is improbable that the finest restaurants in the world would serve oysters and oyster dishes after serving cocktails before dinner or when serving wine or other alcohol with the meal. Actually, oysters and alcohol will have no bad effect on the body provided they both are taken in moderation.

The fact that oysters are said to be inedible during the months without

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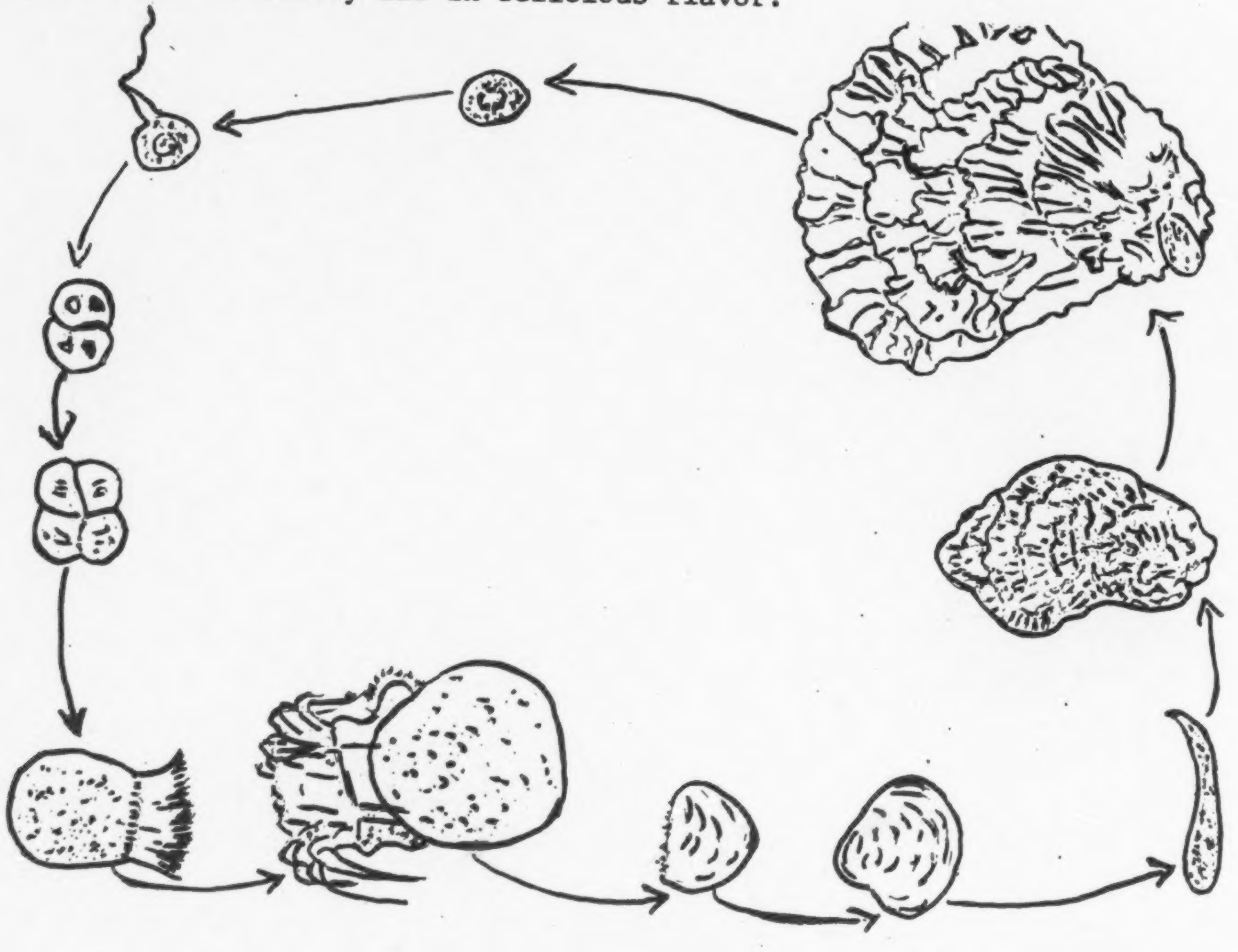
"r" is a very common folk tale and widely believed. There is no truth in this belief. However, in pioneer days oysters were not harvested or sold during the summer months because of lack of refigeration. The oysters will live in their shells only six to twelve hours during the hot summer as contrasted to maybe a week or ten days during the colder months of the year. It is obvious that using a slow sailboat or row boats in attempting to move oysters to market in hot summer months was not practical. It is also true that about this time of the year the oysters are breeding. The American oyster is quite edible during the breeding season; however, the European oyster is not so edible during this season because it is carrying its young in the mantle cavity. Now, with rapid boats, fine refrigeration and ice on the boats and in the transport trucks, oysters can be harvested and eaten the year round in safety and in delicious flavor.



Life cycle of the oyster

BASIC ECOLOGY

By

Robert Murry and Dewey Wills

The word "ecology" is derived from the Greek word oikos meaning house, plus logy used to denote "study of". Ecology then is a biological term dealing with the mutual relations between organisms (plants or animals) and their environment.

Since the best environmental conditions for a particular plant or animal may occur only as a phase in a cycle of changing conditions of plant and animal relationships, we can expect plant or animal numbers to vary with each particular phase.

In order to better understand the role of plant communities in the regulation of animal numbers let's examine a virgin longleaf pine forest site before the trees are cut and as it grows back to second growth commercial timber.

The time is the mid-nineteen twenties, our pine forest contains an almost pure stand of longleaf pine. It has stood much longer than modern forests would be allowed to stand, for indeed the occasional loss of one of the large trees to insects or lightning decreases the total volume of wood more than the very slow growth rate of the surviving old trees adds each year. The trees of our forest are mostly over 230 years of age and have almost completely dominated the site for a long, long time. Gaps in the canopy caused by losses of individual trees have been partly filled with flowering dogwood and blackjack oak. Under the canopy of pines, an accumulation of needles covers the shallow layer of poor top soil. Occasionally a very unthrifty mile pea or butterfly pea plant struggles to survive long enough to produce viable seed. A few partridge peas and tick clovers are also present, and indeed during a wet summer following a winter fire, enough of these annual plants produce seed to make the area attractive to seed eating birds the following fall.

The animal we wish to relate to our forest is the bobwhite quail. These native game birds weigh about six ounces, travel and roost together on the ground in social units called coveys in the fall and winter. They pair in the spring, nest on the ground with both parents looking after the large brood of bumble bee sized chicks that hatch after 23 days of incubation.

During summer, insects are important in the diet of quail as are berries and seed that are available. During fall and winter, the seed of annual weeds and the mast of many species of forest trees provide their principal foods. In late winter and early spring, before insects become commonly available, quail often browse the green leaves of succulent new grasses and weeds.

Since quail are non-migratory, rarely shifting their range in excess of one mile, their daily, seasonal and indeed their entire annual living space must provide at least a minimum of their requirements. Their needs such as food, feeding cover, nesting cover, roosting cover, escape cover and dusting sites must not only be present but must be interconnected. This means that when these elements are encompassed within bare fields or impenetrable ground cover, they must be connected with what is called "travel lanes". Travel lanes are simply avenues of adequate ground cover that lessen the chances of predation and yet afford the birds free movement at ground level.

Back to our virgin longleaf pine forest which contained a modest bobwhite population that tended to fluctuate with the occurrence of winter burning and summer rains. This area was at a stage of plant succession that saw little year to year change in plant communities due to the dominance by the overstory of mature longleaf.

The logging crews moved through the woods and quickly felled the trees. "Skidders", railroad mounted steam engines that employed long cables to literally drag the logs to the logging railroad, were used. The great piles of logging slash of resinous pine were left scattered in a haphazard fashion across the countryside. Fire followed the loggers and left a sea of blackened stumps and charred logging slash that stopped only at the edges of the hardwood bottoms of the larger streams. Large sections of the land were bare of vegetative growth.

The thin layer of top soil however, provided an ideal medium for plant growth and the seed left by prior production of large seeded annual legumes and other forbs did their very best to occupy the site. If there was any kind of seed shortage the first growing season this was quickly corrected after the first crop matured. The top soil, without a protective cover of pine needles, received the full force of all the rains. With few roots to bind the soil, sheet erosion became evident. As rivulets of water found the deep scars cut by the logs, which were skidded uphill and down, gullies were added on the steeper slopes. It was a race between the invading plants whose roots and foliage tended to retard erosion and the seasonal rains. Some top soil was lost, particularly from the sides of the hills. The ridge tops, with less watershed, and consequently less run off and lower water velocity, lost less top soil. The minor stream bottoms often gained soil at the expense of the hillsides.

Our concern here though, rather than soils, is the changing plant communities and the effect these changes had on our study animal, the bobwhite.

The lush growth of invading annual plants made our area ideal year-around quail range. The relatively sparse cover at ground level made for free movement. The denser canopy above provided reasonable security from hawks overhead. The birds foraged at will, utilizing the total area in their search for insects, weed seed and the succulent plants upon which they depended for a portion of their late winter food. These same cover plants produced a bountiful crop of seed. Many were legumes such as wild beans, dollar peas, partridge peas, butterfly peas, milk peas, half a dozen species of tick clovers and several native lespedezas.

The seed of these plants, along with seed from a large number of other important forbs, represented the finest quail foods these lands were capable of producing. Since bobwhite could walk from his loafing covers, (the blackened tops of logging slash), to dusting beds, (the fresh earth diggings of pocket gophers, the dry loamy top soil accumulated in little basins of the newly formed gullies or the well drained exposed soil of storm thrown trees), his roosting cover and nesting cover were both provided by the food producing plants and did not necessitate his use of fence rows or ditch banks as is often the case with quail associated with agriculture. Quail populations flourished and became higher than they had ever been in the history of these lands.

Now we have taken the bobwhite quail from a low population in the old longleaf pine community to the highest in history. Does he still thrive in numbers comparable to those early post-logging years? The answer is NO! In fact, in much of this region, quail populations are lower today than they were prior to logging.

Since we know that the population expansion was due to the ideal habitat conditions created by the invasion of the large seeded annual plants into the void left following the removal of the pines, let us look closely at habitat conditions for an answer to the decline in quail numbers.

The annuals were able to claim the site early because they store relatively large amounts of food in the seed they produce. This food energy gets the seed off to a vigorous start, they develop rapidly and within a single growing season complete their growth. The seed that have matured are scattered by various means and since these annuals die at the onset of winter, these seed represent the only means by which these plants reproduce themselves. By contrast, the light fluffy wind borne seed of perennial grasses are distributed over the area. They are characterized by very small amounts of stored food in each seed. Most of the seed fail to produce living plants because they are very vulnerable to adverse conditions between the time of germination and the production of an adequate root system to gather moisture and nutrients and ample green leaves to process their food. The few that survive do not amount to much the first growing season. They, unlike our friend the annual, however, do not have to start over from seed each spring. The little root system that developed during the first growing season endures the frosts of winter which killed the above ground parts back to ground level. The second growing season, the root system of the perennial is already established and the plant is in better condition to compete with the neighboring annual plants for food, light and water. During the second and succeeding growing seasons, the perennial grows larger tops and develops a more extensive root system. Many small seeded perennial grasses reproduce and spread by means of rhizome production. In simplest terms, a rhizome is a lateral root-like growth capable of producing a whole new plant. Each succeeding year following logging the perennial grasses make up a more significant part of the ground cover at the expense of the annuals.

Frequent surface fires removed the rank above ground portions of these plants. These fires favored the annuals to a certain extent by this removal of competing cover. The well established root system of the perennial grasses, however, made them more than a match for the annuals. They both existed on the same sites. Directly after logging, the annuals had everything their way. The perennials gained each growing season until the annuals were reduced in vigor and seed production to the point that the area became a sea of grass.

Let's look back a moment at our forest, our bird and our whole thread of plant and animal relationship.

We started with mature pines with a few unthrifty annuals and almost no perennial grasses. Following logging, the annuals literally took over. Since the annual plant community fitted the needs of the bobwhite quail, he enjoyed a spectacular population eruption. Even while the quail and the annuals were in their heyday, the perennial grasses were busy invading the site that had been denied them by the former competition from the pines.

They were not endowed by nature with seed that contained a large reserve of stored food so their invasion was slower than that of the annuals. Since, as they reached their zenith, they suppressed the annuals, they also directly caused the decline in quail numbers. In addition to reduced food production, excessive vegetation at ground level prevented the easy movement of birds in search of the food that is produced.

The forest site is not through changing, however. A few upland oaks that had clung to life in the gaps in the pine canopy began to flourish. They seeded in some areas of the former pine site. The perennial grasses provided adequate fuel for hot fires under proper burning conditions. Some seasons, the young oaks experience fire under cool damp conditions, while the oaks were dormant. In many instances, the area went unburned for one or more full seasons. Sometimes, however, spring fires occurred after the young oaks were in full leaf and the trunks and branches were killed. On much of our area non-commercial oaks did manage to establish stands of trees large enough to fire-proof themselves. Since the fuel that supported the hot killing fire was largely the frost killed perennial grasses, the oaks, by shading out these sun loving grasses, reduced the production of fuel on the area.

The few longleaf pine seed trees left on the area, although generally of poor form and vigor, were stimulated to cone production by the removal of the other trees. The windblown pine seed that touched mineral soil, where moisture was adequate, germinated and became a pine seedling. If it escaped a fire the first year of its life it was capable of surviving grass fires for the several years it usually remained as a grass-like seedling without an above ground stem. It was vulnerable to fire the year that rapid height growth was begun, but became again very resistant to ordinary grass fires after that time.

Loblolly, another species of pine, was moderately successful in invading the site. Although it is less fire tolerant than longleaf, it is much more tolerant of shading. It started height growth the first growing season and invaded along the branch bottoms and on the hillsides, intermixed with the upland oaks where they had shaded out some of the perennial grass.

Conditions favorable for establishment of pines or oaks tended to exist over various sized portions of the area. We find almost pure stands of one of the pines, or of one species of upland oak on portions of the area. We also find mixed ragged stands of pine-oak forest. This is especially characteristic of loblolly which we find occurring with from one to several of the oaks. This mixed forest still contained large patches of perennial grass roughs. All of this developed during a period of no deliberate management by man. His livestock in some instances affected the forest stand and his fires in many instances influenced the forest composition.

Quail populations had declined from the early post-logging period and could be termed "moderate".

Next, man, realizing some of the economics of forest management, reenters the picture in a positive way. He begins to deliberately grow another crop of pines to replace the forest originally cut. He removed much of the non-merchantable hardwoods. He planted his grass roughs with young pines. By controlling fire while young pines, mostly loblolly, were vulnerable, he established extensive pine plantations over large areas of this former longleaf land. He left only the naturally seeded pine that had become established dense enough to be reasonably free of limbs on the lower trunk.

As the young pines grew and their spreading crowns formed a tight canopy, the perennial grasses were again confronted with their old enemy-shade. Individual clumps died one by one and those that remained became less and less thrifty. After a few years, a carefully controlled fire was allowed to consume the accumulated litter of pine needles and dead grass. This speeded the loss of lower pine branches and resulted in young saplings of better form.

These stands of dense young pine represented the very low point in bobwhite carrying capacity and of course the birds responded to this by becoming very scarce throughout the area. The pines, however, refused to stay young and densely spaced. As they grew older, the landowner was able to harvest forest products such as posts and pulpwood, leaving the better trees to produce higher value poles, pilings and saw logs. With each thinning, the increased amount of light left the forest floor ready to harbor an understory of undesirable hardwood brush. The manager used fire under favorable burning conditions to retard the invasion of such plants. The perennial grasses are now virtually gone. The more shade tolerant annuals are still present in limited numbers. Quail populations are better now and the very first season after clear cut logging of this second timber crop occurs, they are ready to expand along with the annuals. The cycle of the woodland bobwhite quail and the pine trees is completed.

The preceeding example of basic ecology has ignored the many insects, song birds, and mammals that were influenced by the changes that occurred in the plant community. It has not attempted to fully treat the continuing life and death struggle of the different plants with their various adaptations for survival under a particular set of conditions. It has not dealt with the influences that animals may have had on the plants that failed to maintain a favorable position in the second forest.

Many examples of the basic ecological relationships of plants and animals are near us. When the shade tree dies in the yard, lawn grasses extend their coverage to include the spot formerly kept bare by the severe competition of the tree. As the grasses occupy the area, insects and other invertebrates that thrived under the conditions imposed by the shade tree gave way to those kinds of animals we would expect to encounter associated with lawn grasses.

LOUISIANA WILDLIFE: ITS RELATION TO FOREST AND FARM

The early history of game populations in Louisiana has been adequately covered by Dr. Syle St. Amant (1959) in his book "Louisiana Inventory and Management Plan." For the specific reference, see Pages 29 through 31 and pages 36 (beginning with the third paragraph) through 40. Land use and its effect on game populations until 1880 are discussed by Dr. St. Amant on page 41. (See end of this section.)

Before 1880 the state had slowly changed from an Indian hunting ground to a thinly settled area dominated by white man's civilization. Although the new comer depended more on farming and domestic livestock, he turned to game and fish to supplement his food supply. In fact, with superior equipment for harvesting game, heavy inroads were made on most game species, especially turkey and deer.

These early settlers depended largely on water transportation to bring in needed supplies and to take their produce, mostly cotton, to markets. Thus, most of the earlier settlers located along the larger streams. The streams also provided transportation for logs cut from cypress and the better hardwoods growing near their banks. When fields were cleared some distance from streams, the timber was cut, piled and burned. Even near the streams, only the high quality species went to market; all others were piled and burned.

The timber of the forest placed a heavy burden on the farmer who needed open land for the cultivation of crops. Hand labor with rather crude tools was necessary to remove the trees. It required hard work extending over long periods to turn timbered forest land into cultivatable farms. But by 1900, the picture changed drastically. The railroad had made its appearance. Many large lumber companies were cutting out their timber holdings in the coniferous forest of the Lake States and were looking for unharvested forest stands. The great forest stands of Louisiana and the entire deep South beckoned to them. The U. S. Congress set the stage by placing a price of $1.25 per acre for virgin timber land.

The timber industry moved South. The table and graph presented tells the story in Louisiana. The harvest of timber had increased slowly in Louisiana until about 1900. The peak was reached in 1913 when Louisiana led the nation in lumber production. In some 30 years, most of the big lumber companies had cut out and had moved westward.

Before we turn to the effect that this rapid cut of the virgin forest had on wildlife, let us look at the economic implications. In one parish in West Louisiana (Vernon) pine timberland assessment was $6,772,752 in 1926. That dropped to $2,367,662 in 1929, and to $1,163,090 in 1932. The total assessment of timber, timber land, and manufacturing of equipment for the same three years was $13,883,276, $8,506,333, and $3,909,999 respectively.

Wildlife populations require a suitable habitat if high populations are to be maintained. There must be a plentiful food supply for each and every day of the year. There must be cover suitable for nesting, resting, feeding, roosting for birds and escape from its enemies including man and his dogs. Many species require drinking water daily. Even though these requirements are met, a flourishing game population is not insured. The take by man must be controlled. To limit destruction by man, the market hunter has been outlawed and open hunting seasons and bag limits established.

The wide expanse of forest at the beginning of this century with small farms intermingled was not teeming with game. Turkey and deer were scarce in the pine and mixed pine - hardwood forest before the loggers wide spread sweep. Unlimited killing by man both for home use and the market had taken its toll. Although there is little real knowledge of earlier game populations, there is evidence that white man had taken far more than the annual production.

During a few short years at the beginning of this century many thousands of acres of pine forest were reduced to a sea of stumps. Following the removal of the forest trees, annual fires kept these areas open. For a few years following logging, bobwhite quail and rabbits increased. However, cover for deer and turkey was absent, and the scattered populations of fox squirrel moved into uncut hardwood bottoms. Eventually, bobwhite and rabbits left the wide open areas and concentrated on the borders of the cutover pine forest and the vegetated hardwood bottoms. In more recent times, fire protection, associated with wide spread artificial and natural regeneration, has established cover over most of the forest areas. The added food and cover plus a very successful re-stocking program has brought deer to most Louisiana forest. However, the same process of fire control and increased forest cover has not increased the carrying capacity of the forest for bobwhite and cottontail rabbit. Actually, in the re-established and unburned forest, populations of these two species are very low.

The loss of most producing hardwoods through harvesting operations and agricultural land clearing is having an adverse effect on some game species. The U. S. Forest Service reports that hardwoods of merchantable size decreased 23% between 1954 and 1964. In the lower Mississippi and Atchafalaya Delta, tupelo and black gum predominate. In all other hardwood stands, the greater portion of the stands is composed of oaks, hickories, and pecans, the fruit of which is prime food for squirrel, deer, and turkey. If this cutting trend in hardwood continues, squirrel in particular will suffer.

Louisiana has two outstanding game species classified as farm game--the bobwhite quail and the cottontail rabbit. During recent years, the quality of the farm habitat for these two species has continually declined. It is necessary to examine the history of our farm land to understand this change.

The area in acres classified as farm land by the U. S. census has remained surprisingly constant over the last half century -- 10,439,481 acres in 1909, 10,347,328 acres in 1959. Even though the total farm acreage has remained relatively constant, marked changes have occurred in its location. Many small farms in the upland hilly sections have reverted to pine or pine-hardwood; many thousands of acres of the delta and other bottomlands have been cleared of hardwood timber and put into cultivation.

The size of individual farms has increased as the total number decreased -- from 161,449 in 1929 to 74,438 in 1959. Still the number declines and in 1968 there were only about 60,000. As time passed, farming became more competitive. With more machinery being used, farms had to be larger, fence rows were eliminated, ditches were filled in or cleaned out. To cut cost, flame cultivation and chemical weed control were introduced. Most successful farmers now grow two or more crops per year on the same area. At no time are large fields left fallow thus creating feeding grounds for game.

There has been a great change in the number of farm acres devoted to the various crops. Until fairly recently, standing corn was left in the fields throughout the winter. They provided ideal feeding grounds for bobwhite, but no more. In 1939 there were 1,630,715 acres in corn; in 1959 there were only 396,799. Today there is even less, and very little is left standing through the winter.

The continued growth of the livestock industry has required more and more improved pastures. The total acreage reached 2,033,024 in 1959 which is more than double the 915,839 acres in 1929. The well managed improved pasture is a poor game habitat. Continuous grazing and clipping keep plants low. Rabbits use the edges but do not venture far from adjoining cover provided there is enough to maintain a rabbit population. Bobwhite are able to make even less use of the improved pastures than rabbits.

Farm woodlands have continually occupied 2 million or more acres of the farmland. Under proper management, they can add much to the farm game habitat. However, good management for increasing production of timber, especially fine, often is detrimental to game. Complete fire control, removal of low value hardwoods, and the establishment of dense young stands of pine greatly decrease the carrying capacity of the forest for game.

Small farms intermingled with cutover or lightly forested areas, most of which burned periodically, created an ideal habitat for many game species. We will never see this again. We may never again see the high bobwhite and rabbit populations that those conditions spawned. It will be necessary to make a new approach if we want wide spread shootable populations of these species.

(This section was written by Dr. John Bateman.)

LOUISIANA LUMBER PRODUCTION

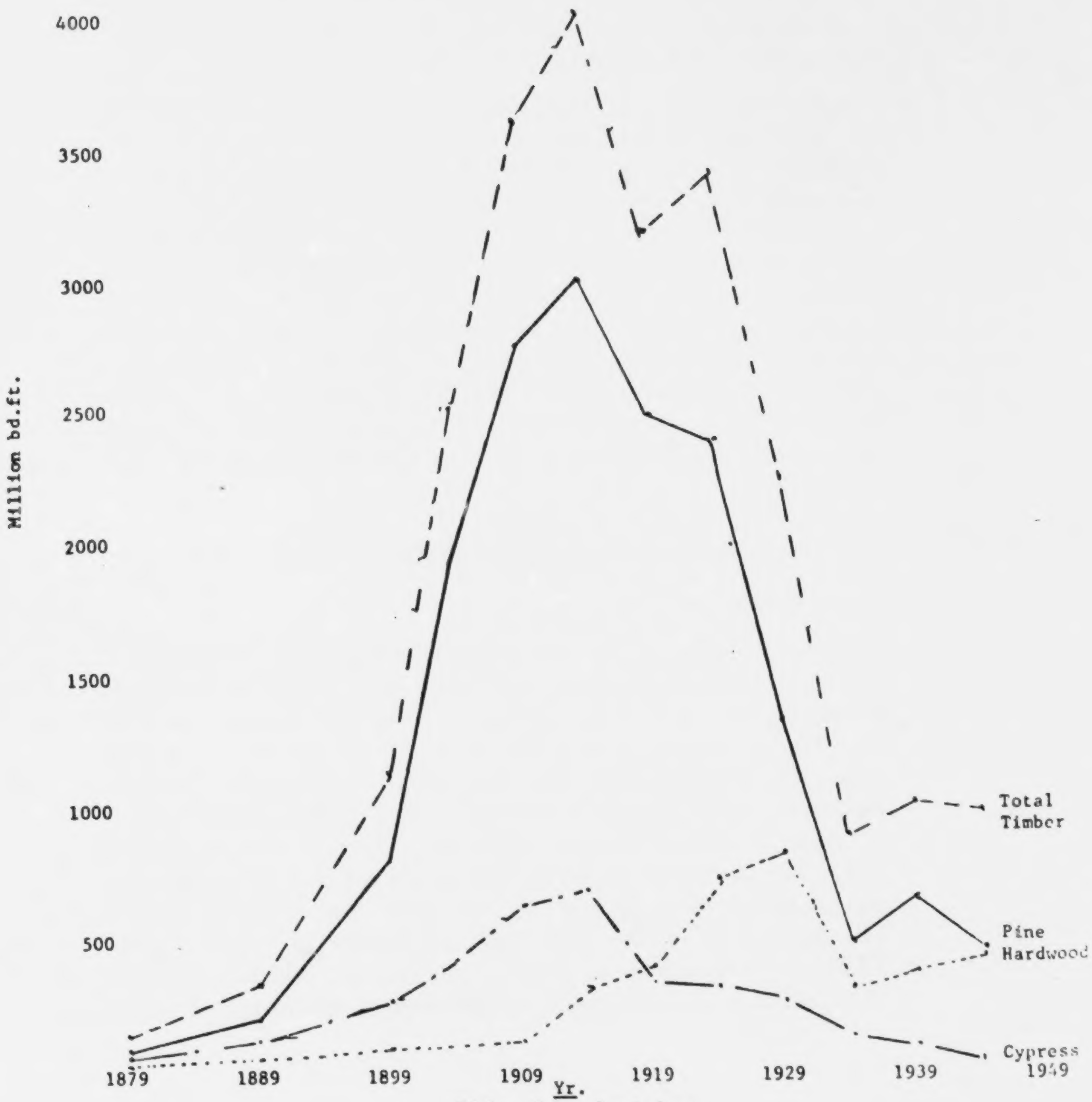
Million Board Feet

Year	Hardwood	Cypress	Pine	Conifer Total	Total
1869	16	7	53	60	76
1879	15	45	73	118	133
1889	20	100	186	286	106
1899	72	249	794	1,043	1,115
1904	97	432	1,930	2,362	2,459
1909	206	608	2,737	3,345	3,552
1914	313	672	2,970	3,645	3,956
1919	385	308	2,470	2,778	3,164
1924	702	300	2,395	2,695	3,397
1929	814	112	1,306	1,418	2,232
1934	284	35	456	490	775
1939	349	74	613	688	1,036
1944	422	31	486	517	940
1946	512	29	518	548	1,060

Peak Year

Hardwood	1929 - 814,000,000
Cypress	1913 - 745,000,000
Pine	1913 - 3,092
All timber	1913 - 4,162

Peak cut Hardwood - 814 million - 1929
Cypress - 745 " 1913
Pine - 3,092 " 1913
All Timber - 4,162 " 1913



Timber Cut - Louisiana

A GENERAL HISTORY AND DESCRIPTION OF GAME RANGE IN LOUISIANA FROM 1700 TO 1950

In order to understand the game conditions in Louisiana at the present time and in order to devise efficient and economically sound management procedures for the restoration and maintenance of proper game conditions, it is of vital importance to know how the present situation evolved. Unless the causes behind the changes in game conditions are known, there is little hope of ever producing a stable, well managed game supply in the State.

An examination of the history of game in all areas studied in the United States thus far, indicates that changes in game conditions are tied in with the history of the areas in question and particularly with changes in forest and farm lands, with industrialization, and with fluctuating human populations in the area. In other words, the land use pattern has governed the game picture more than any other single factor. In this section of the report, an attempt is made to describe as accurately as possible Louisiana's game ranges and species as early as records are available to give a short, general description of the present conditions for comparative purposes, and to make a step by step analysis of the causes and basic changes that have brought about these later conditions.

ORIGINAL GAME CONDITIONS IN LOUISIANA

Game Habitat:

Any attempt to describe accurately the game conditions of Louisiana as the first white man found them might be considered hopeless since most of the histories of the State fail to do more than barely mention wild game. A search of the literature, however, does bring to light the writings of a few early travelers, historians, and naturalists who give us a rather broad picture of game conditions in the early days. DuPratz (1758), writing about his travels in Louisiana between 1718 and 1734, gives us an unusually vivid picture of the game habitat as he saw it. His description of the kinds and distribution of types is good. DuPratz's observations on game populations are probably questionable except in his description of extremes of abundance or rarity.

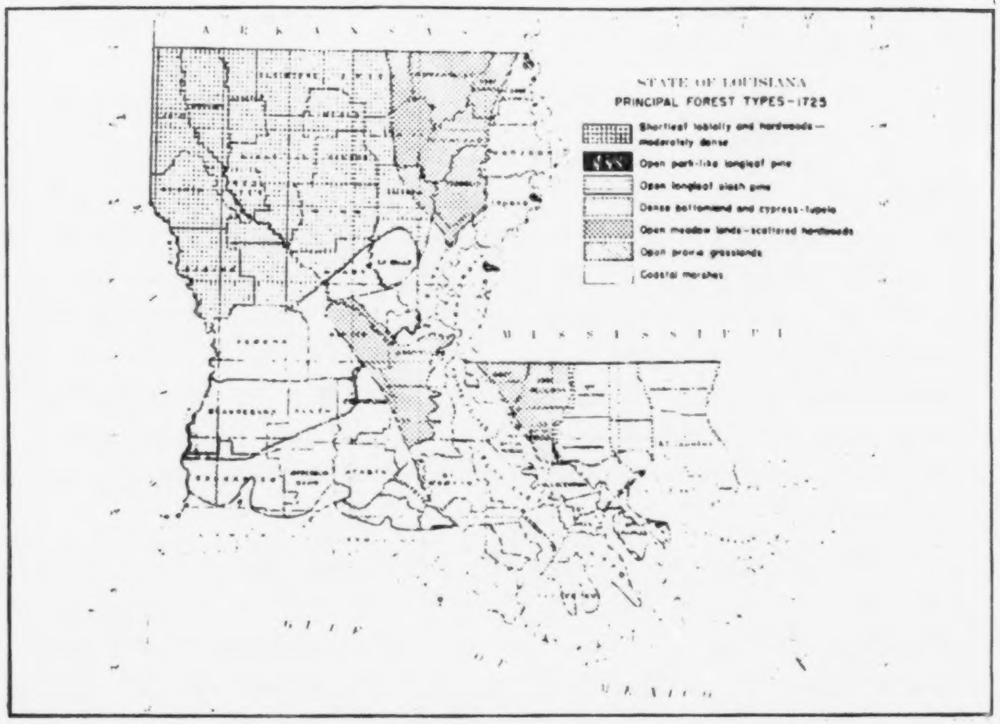

STATE OF LOUISIANA
PRINCIPAL FOREST TYPES-1725
Shortleaf loblolly and hardwoods—moderately dense
Open park-like longleaf pine
Open longleaf slash pine
Dense bottomland and cypress-tupelo
Open meadow lands-scattered hardwoods
Open prairie grasslands
Coastal marshes
ARKANSAS
MISSISSIPPI
GULF OF MEXICO

FIGURE 7.

Audubon and other naturalists studied at an early enough date to verify most of the species reported by earlier writers.

Perhaps the most striking thing reported about Louisiana by early visitors was the arrangement and general productivity of the forests, prairies, and meadows. It also is interesting to note that these first explorers recognized the relative merits of different parts of the State. Contrary to popular belief, Louisiana was not covered by a solid forest. Apparently, many large areas besides the natural prairies of southwest Louisiana were open meadow type lands. Whether these open meadow lands were natural or the result of fires set by the Indians is not clear. Early writers speak of the annual, almost ritualistic fall burning of the grasslands by the Indians. This practice carried on for many years may have well prevented the formation of a climax hardwood forest. These meadows contained scattered patches of hardwoods which dotted the grasslands and formed strips along the streams. This type of condition existed in the areas between the Amite and Mississippi Rivers, north of Bayou Manchac; between the Ouachita and Tensas Rivers; and in the vicinity of Avoyelles, St. Landry, and southeastern Rapides Parishes. (Fig. 7). Such areas apparently were confined to the alluvial cone units described earlier and to the better bluff and terrance soils of the Western Florida Parishes.

The remainder of Louisiana, excepting the marshlands and the southwest Louisiana prairies, was virtually solid forest lands. (Fig. 7). The northwest Louisiana hill lands were clothed in a pine-hardwood forest with short leaf, longleaf, and loblolly pine forming the major part of the stand. The understory was semi-park like, but well supplied with shrubs, young hardwoods, and other foods suitable for game. The streams and bottoms throughout this area were more thickly grown up in hardwoods. The early settlers recognized this area as suitable for settlement but noted it to be less productive than the open meadows and alluvial areas.

The alluvial lands along the Mississippi River and bordering the coastal marshes were apparently covered by a dense growth of climax hardwoods with an almost impassable under-story of switch cane (*Arundinaria tecta* and *A. gigantea*) and palmetto (*Sabal minor*). In the lower regions of the State and bordering the coastal marshes in the southeast, the early explorers found vast cypress-tupelo swamps that were flooded annually because man-made levees were not in existence to protect this area from the high waters of the Mississippi. The very first settlers considered most of this alluvial land too wet to cultivate but they knew that the light, better drained soils on the crests of natural levees were extremely fertile. This fact, plus ease of transportation by water, led eventually to the growth of the large plantations along the river.

The long leaf pine forests which covered most of the terrace lands in Louisiana and which were more or less continuous with the southeastern coastal pine belt presented to the early traveler a solid park-like stand of majestic pines. The under-story was clean and except for the shrubs and small hardwoods along the small creeks offered little food for game. DuPratz and other explorers looked upon this great pine area as sterile and valueless because the virgin pine forest and poor sandy soils were not considered to be productive enough of game or crops to maintain settlement. The coastal marshes and parts of the western prairies of Louisiana are not well described because early explorers considered them not suitable to sustain settlement and therefore did not visit them.

EARLY GAME TYPES, THEIR DISTRIBUTION AND ABUNDANCE AS COMPARED WITH THE PRESENT

In attempting to describe early game types, a decision must be made as to what types constitute game and which are the non-game types. For the purpose of this discussion, all types that were taken by man for food or clothing and those types seriously hunted as predators are considered as game.

Table 2 is a listing of the game types reported in 1700 as compared with the same species today. Early abundance and distribution was determined as completely as possible from available literature, but it is doubtful if the observations in some cases were sound, particularly, in regard to abundance of the species recorded. Early observers based descriptions of abundance and rarity in a great many cases on the relative amount of one species as compared with another or else they compared estimates with European conditions rather than basing these estimates on a density per unit area standard. For example, bobcat, otter, cougar, and quail are all reported to be rare or only occasional, by observers. This may have been true for the quail which had little range, but the range of the other three species was extensive and excellent. More likely, these reports resulted from the fact that these animals were extremely wary or few in number when compared to other species. On the other hand, the term abundance used by early writers was obviously a direct comparison of Louisiana's game supply with that of Europe where game was probably already scarce. It is obvious that the terminology as used here and in any of the literature must be purely relative. Later in this discussion, a comparison of early and present-day populations based on range carrying capacity will be offered.

The species as listed in Table 2 may be broken down into four major groups as follows:

1. Species that once ranged in the State and are now extinct or absent from the area. In this group are the buffalo, elk, greater prairie chicken (Att water), and passenger pigeon. The buffalo, at one time, apparently ranged over most of Louisiana in considerable numbers. Early writers report it in the vicinity of New Orleans and Baton Rouge around 1700 and it was reported at various times in the open lands west of the Mississippi River. The bison was reported to shun dense, forested areas which would indicate that those reported east of the Mississippi must have come down from what are now the States of Mississippi and Tennessee and did not cross the dense bottomland forests along the lower Mississippi River or the river itself. Apparently, the buffalo could not survive civilization and extreme hunting pressure. It was rapidly driven out of Louisiana. Lowery (1943), from a study of the literature, reported that the last one was killed near the present site of Monroe, Louisiana, in 1803.

There is no authentic evidence that elk ever occurred in Louisiana. DuPratz reported it on several occasions between 1718-1735 in the denser forests of the higher lands of Louisiana. His observations could have well been made in what is now the State of Arkansas or even as far north as Missouri since he traveled widely. Anthony (1935) reports the original range of the elk to be between the 35th. and 50th. parallels. This would place the range out of the present boundary of the State of Louisiana, but it is conceivable that elk may have occurred in northern Louisiana.

The prairie chicken ranged in goodly numbers over the prairies of western Louisiana. Probably, it also occurred in the meadowlands east of the Mississippi and in the vicinity of the Macon Ridge. (Fig. 7). This fine game bird was finally driven from the prairies of Louisiana by advancing civilization and market hunting in the early part of the twentieth century. The last bird authentically reported in the State was seen in Cameron Parish in 1919 by A. M. Bailey. (Bailey and Wright, 1931).

Stories of the passenger pigeon in Louisiana, as well as over the central part of the United States, are numerous. Apparently, the early settlers saw such great numbers of these birds that it staggered their imagination and left them at a loss for a description suitable for the spectacle. There is ample evidence that the great numbers of pigeons that arrived in the fall would literally strip miles of mast-producing forests and grain crops of all the available food. These birds disappeared from Louisiana as the national population was eliminated by destruction at their nesting sites, mass killing and trapping, and, finally, by the loss of habitat as a result of the advance of civilization.

2. Species once numerous to common in the State now rare, sparse, or protected: In this group are the cougar, bear, wolf, beaver, otter, wild turkey, snipe, upland plover, swans, and cranes. The cougar, bear, and wolf were common in early days. Bear were particularly numerous in dense hardwoods along the Mississippi and other streams. According to DuPratz, they were more abundant in winter since they were driven south ahead of the early snows before hibernation! Cougar and wolves were found in areas where game that they preyed on was plentiful. Cougar apparently were never very numerous or else they did not remain in the vicinity of habitation for long. Wolves followed the hunting parties and fed on the offal. Beaver and otter, once fairly plentiful, were found in most aquatic areas of the State. They remained plentiful until heavy trapping for the market and a great reduction in suitable range reduced their numbers to very few.

Turkey,* upland plover, and snipe* all were much-sought-after game birds for the market, for home consumption, and for sport. The turkey ranged over most of the forests of Louisiana except the wetter swamps, while snipe and plover were confined to wet meadows, pastures, and prairies. Heavy gun pressure on these fine game birds coupled with great range reduction in the case of the turkey and the effect of severe winter weather on the shorebirds has reduced their numbers in the State so that they have been removed from the list of huntable game.*

Swans and cranes, once common among the myriads of waterfowl, are now extremely rare in the State. Most of them were eliminated by the early part of the twentieth century.

All of the species in this group still occur in the State to some extent and many offer a good potential for building up huntable populations. These will be discussed in detail later in the report.

3. *Species now taken only for fur or because of predation:* This group includes the bobcat, fox, beaver*, raccoon, opossum, muskrat, mink, and skunks. All of these species, with the exception of the muskrat, were numerous in early times. For the most part, they ranged over the entire State, but the most dense populations naturally were centered in the type habitat best suited to the species. For example, the aquatic or semi-aquatic forms like mink, muskrat, otter, beaver, and raccoon were no doubt more common in southern Louisiana and along the river and stream courses. High land types

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*Snipe & turkey have since been placed back on the list of huntable game.

*Included in groups two and three because they are fur bearers as well as rare.

were probably more numerous in the less dense dry hill forest. Although it is generally assumed that all of these animals were taken for fur in early times, most of the evidence points to the fact that the larger types like bear, buffalo, deer, fox and beaver were in the greatest demand. The small types apparently were not molested much until fur began to be a luxury rather than a necessary part of clothing. For the most part, the populations of the smaller fur types remained high until near the end of the nineteenth century when the ranges of these animals were greatly reduced by timber operations, drainage, and farming and when the demand for luxury furs reached a peak. At present, all of this group except beaver and otter still exist in reasonable numbers on the remaining range. The muskrat is the sole exception to this general picture of the fur animal. It is not reported at all by early writers. Studies by O'Neil in 1949 indicate that muskrat may not have been in Louisiana much before 1850. At the present time, the animal is confined in this State primarily to the coastal areas. It is our most abundant fur producer and the mainstay of the entire fur industry of the United States.

4. *Species that are still hunted as game:* Under this heading, we have those game species that have been able to survive the coming of civilization, changes in range, and much hunting pressure and still remain numerous enough on the available range to furnish reasonably successful hunting. In this group are deer, squirrel, and rabbit representing the quadrupeds and the quail, dove, woodcock, and waterfowl representing the birds. In considering the early conditions of these species, we find that some were numerous and some were apparently not so plentiful, yet all have managed to survive. Deer and squirrel were apparently quite numerous over all of the present State of Louisiana, but in all cases the type of range has governed the size of the population. Deer apparently were most numerous in the mixed pine-hardwood forests and on the edges of prairies and meadowlands. The longleaf pine lands did not support large populations and, surprisingly, the swamp and dense river bottom areas, which now contain most of our deer, at that time were too dense and grown-up with cane and palmetto to support many. After the forests were cut, however, the brushy second growth hardwoods occurring in the bottomlands furnished an excellent, though limited, deer range. On this range, there is now found 93% of all of the deer in the State excluding the coastal marsh. (Fig. 6).

Squirrels were quite abundant in early times, but were most concentrated in the mast-producing mixed oak and hardwood areas. The pure stands of pine and the treeless prairies and marshes produced the smallest populations. Squirrels have perhaps survived best of any species. They have lost considerable range with timber operations and the advance of civilization, but where the range is available, populations are good, even at present.

The early position of the rabbit as a game animal is not too clear. In all cases, it was reported to be abundant and to range over the entire State. On the other hand, predation must have been heavy. Then, too, the clean floor of the virgin forests was probably not as good for rabbits as the highly productive areas occurring with increased farming in late years. In all probability, the peak in rabbit populations occurred sometime in the late nineteenth or early twentieth century.

Quail and dove were uniformly reported to be rare or occasional in early times. Since they are both seed and grain eaters, this is understandable. Early range conditions were not highly productive of suitable foods and the total populations were probably governed by this limiting factor. Peak population of these two species occurred much later, between 1880 and 1920, where farming was extensive but crude and when thousands of acres of timber lands were cleared increasing the range of these species.

Early writers reported woodcock and waterfowl to be quite abundant on their wintering range in Louisiana. Waterfowl, in particular, were reported to be in every available pond, lake, watercourse, and marsh. Just how much greater the populations of these species were in early times than they are now is difficult to estimate. Terrific gun pressure for food, sport, and market was placed on these species by 1850. No reliable records are available to show whether there was a marked decline in populations at this time. Later records on market kills do not show a sudden drop in waterfowl populations. The waterfowl wintering range in Louisiana has been reduced by drainage, civilization, and the encroachment of water hyacinth. This reduction of range has no doubt aided in the decline of waterfowl, but this is not believed to be the major cause of reduced waterfowl populations in the State. Factors operating outside of the State on the nesting range and gun pressure in all areas have influenced national populations and tend also to control the waterfowl wintering population in Louisiana.

AN ANALYSIS OF THE CHANGES IN LAND USE AND ITS EFFECT ON GAME

As pointed out in the preceding section, the basic causes behind the changes in game conditions from past to present are the changes that have occurred in land utilization. This concept is not original with this investigator, but rather is one of the basic concepts of game management as practiced today. It is widely supported by many authorities in the field and needs no verification at this point.

In order to see clearly the basic changes in land and its effect on game in Louisiana, it is best to divide the history of land use into four stages. These are: stage I, before the coming of white man until 1800; stage II, 1800-1880; stage III, 1880-1925; and stage IV, 1925-1950. Each stage is shorter than the preceding one since as civilization progressed, it took less time to change the land use pattern enough to have a marked effect on game. Graph 1, Fig. 8, shows the trend in game abundance during the various stages of land use from 1700 to 1950. The terms abundant, absent, rare, etc., used to designate the amount of game at various times is relative to each species individually and is based on the available historical evidence. The graph along with the following discussion of each stage is designed to show the trends in game conditions over the years and the basic causes behind these changes.

Stage I: From before the coming of the white man until 1800. During this time, the State was a virgin wilderness with only a few trading posts and settlements. The white man's presence in the area was insignificant as far as hunting pressure was concerned while hunting pressure from the Indians had been a stable condition.

Several facts about the game of this period may be unknown by the average sportsman of today. It is generally assumed that, during early times, game was abundant everywhere. This was not necessarily the case. As pointed out in the preceding section, even the abundant species were concentrated on good ranges while on poor range game was scarce. This was so true that the Indians divided the hunting grounds among the tribes and practiced game conservation on a limited scale.

MARSH MANAGEMENT FOR WILDLIFE

by

Robert H. Chabreck

The Louisiana coastal marshes are one of the unique geographic areas in North America. The marshes, expanding the full coastline of the state and varying in width from 10 to 50 miles, cover approximately 4.5 million acres. Since they extend inland from the Gulf of Mexico for such great distances widely varying conditions occur. Also, the rich sediments from the Mississippi River Valley, coupled with a favorable climate, produce dense growth of vegetation and a wide range of plant species.

The Louisiana coastal marshes are among the most productive natural areas on earth and the abundance of vegetation has greatly enhanced the value of this area for fur-bearing animals and waterfowl. A long growing season coupled with a daily tidal fluctuation which ranges only slightly over one foot between high and low tides add greatly to the productive capacity of this vast area. The numerous bays, lakes, and streams within this area serve as nursery grounds for marine fish and crustacea and make Louisiana a leader in the field of commercial fisheries. The coastal marshes in Louisiana serve as a winter ground for several million ducks, geese, and coots and is a habitat for various types of fur-bearing animals. Waterfowl from the vast Mississippi and Central Flyways concentrate here during the wintering period. Flights of blue-winged teal begin arriving in late August and early September. The migration of other birds follows and continues throughout October and November with peak populations being reached in early December. They depart in March making a total of seven months that migratory waterfowl spend in the coastal area of Louisiana.

The coastal marshes not only serve as a haven for the millions of migratory waterfowl, but provide habitat for other game birds such as rail, gallinules, snipe and numerous other shore birds including herons, egrets, and ibises. Also, deer and rabbits are abundant game species throughout much of the coastal area.

The fur industry of Louisiana is of national importance and Louisiana is far ahead of other states in this field. Several million pelts are harvested in the coastal area each year by trappers. The nutria, muskrat, mink, otter, and raccoon are the principal fur-bearing animals in Louisiana. At one time the alligator was taken in tremendous numbers for its skins, but in recent years the alligator population has declined so low, as a result of excessive hunting, that the animal is practically non-existant over most of its original range. Concentrations of alligators are now found only on wildlife refuges or similar areas providing rigid protection.

Because of the high potential value of the coastal marshes of Louisiana, land owners or land managers should take special care to insure that proper conditions exist in the marshes for maximum production of wildlife and plants. Very often only slight modifications in water depth or water salinity can make a difference between a productive and a non-productive area.

Marshes and the associated water bodies subjected to extreme water conditions usually provide poor wildlife habitat. Ponds and lakes influenced by extreme tidal action and drastic salinity changes usually support undesirable plant types. Consequently these areas are of little value to either waterfowl or fur-bearing animals. Only by careful planning and management can the productivity of these marshes be returned or maintained at a desirable level.

With proper management coastal marshes can be manipulated to improve habitat conditions for wildlife. This management is quite costly and the benefit gained from a development program is usually in proportion to the amount invested and the skill with which the program was planned. Unfortunately, marsh owners frequently launch large scale development projects without fully understanding the problems which they are trying to correct. Usually planning by persons familiar with the problem will reduce the cost of the program and increase its effectiveness.

In managing coastal marshes for wildlife the objectives should be aimed at increasing the production of resident species and making the area more attractive to migratory species. This can be accomplished by habitat improvement, not only by increasing food production, but also by making the food more available and by creating a suitable balance between marsh areas and open water.

The ideal coastal marsh management procedure should be capable of accomplishing several effects. Basically, it should reduce water level fluctuation, prevent drastic salinity changes, minimize water turbidity and reduce the rate of tidal exchange. But mainly, the technique should produce stands of desirable vegetation in the marsh and marsh ponds.

In planning a large scale marsh management project, the marsh owner or manager should give careful consideration to several points. First of all, the purpose of management should be thoroughly understood. The manager should decide the wildlife species that he wishes to produce in the marsh or attract to the marsh. Usually, ideal conditions for one group are not considered ideal for another. Secondly, for intelligent management in the marsh it is essential that the manager be able to identify the common plants throughout the marsh area in which he will be working, since the manipulation of plant communities will be the primary goal in the management program. The third point which must be considered by the marsh manager is the water level and salinity requirements of the plants with which he will be working. For best results, the marsh manager should be able to control water levels and salinity in the area under consideration; therefore, a knowledge of the water level and salinity requirements of the plants with which he is working is essential. By manipulating water levels and salinities over a period of time the marsh manager can either encourage desirable plants or discourage undesirable plants until the desired conditions are thus created.

It should be emphasized that all plants have a definite range of tolerance for water salinity and water depth, and generally plants will grow so long as the conditions are within this range. Whenever the water salinity or water depth goes above or below the desirable range for an excessive period of time, the plants occupying the site will usually disappear. Then another group of plants, whose requirements have been met as a result of the change, will generally take over the area.

Fresh and salt marshes all produce several good wild life food plants, but during the change from one type of vegetation to another the marsh will often remain bare of vegetation until the invading plants have had an opportunity to take over. When this happens, wildlife food and frequently cover are generally unavailable. Consequently, the animals depending on the plants in the area for food and protection disappear. Experience in the coastal marsh region has shown that brackish marsh conditions are the most productive for wildlife and by controlling salinity and water levels the maximum benefits can be obtained.

An excellent combination in coastal marsh management is considered to be the production of three-cornered grass, spikerushes, wild millet and other seed producing annual plants in the marshes and widgeongrass in the marsh ponds and lakes. Three-cornered grass is the choice food of blue geese and muskrat on the gulf coast, and wild millet and seed producing annuals and widgeongrass are choice food plants for ducks.

The primary goal of the marsh manager interest in waterfowl should be to improve conditions for wintering waterfowl. The Mottled Duck is the only species nesting in Louisiana in sizable numbers; consequently, efforts should not be made at improving nesting conditions under normal situations. The goal of management should be directed toward increasing food production and regulation of water levels to make this food available. Techniques which can be applied by the marsh manager include manipulating water depth, controlling salinity, grazing regulation, burning, planting, creating mechanical openings and chemical control of undesirable plants.

In order to be able to regulate or manipulate water depths the marsh manager must have an impounded marsh area which is enclosed with a continuous levee. Constructing the necessary levees is very expensive and normally out of question in most areas; however, in others the necessary levee systems may already be present and require only slight modification for use by the manager. Where water level control is possible, draining the water from fresh or brackish marshes during the spring or early summer will permit the soil to dry and grasses and sedges to germinate and grow in the areas not vegetated. Then, reflooding the marsh will attract ducks to the area and make the seeds produced available to the birds. The drying procedure is essential for plant germination to take place; however, reflooding can be done a few weeks after germination so long as the new plants are not covered with water.

Impoundments have been widely used throughout the coastal area of Louisiana for marsh management. This type of management has been particularly effective in improving marshes for ducks. However, marsh impoundments have certain disadvantages which at times make it necessary for land owners to seek other types of managment. First of all impoundments are costly, not only to construct, but also to maintain. Also, without facilities for pumping water, years that are unusually wet or dry generally result in poor food production. While impoundments greatly improve habitat conditions for ducks, certain other valuable species such as fur-bearing animals, geese and marine organisms are not improved and are often made worse. A limiting factor in the use of impoundments is location. Impoundments can be built only in areas which will support a continuous levee. Because of the fluid nature of the subsoil in certain sections, particularly in Southeastern Louisiana, impoundments can be constructed only under special conditions.

Other methods have been employed to improve coastal marshes for wildlife. These include weirs and earthen plugs in the drainage systems of a particular area and ditches and artificial potholes in the marsh. All of these methods have been used and all with varying degrees of success. Before planning a marsh management program using these methods, persons with experience in this field should be consulted.

The weirs have proven very beneficial for marsh management for fish and wildlife when properly placed and properly constructed. Weirs resemble dams constructed of steel or wooden sheet piling with the top about 6 inches below the natural elevation of the marsh. Weirs do not completely block the flow of water, but prevent drainage of marshes on low tides and reduce the rate of tidal exchange. The ponds behind weirs produce far more aquatic vegetation than do natural ponds and are thus far more attractive to wintering waterfowl. Also, marshes behind weirs and earthen plugs hold permanent water levels thus improving access to the marsh for trapping and hunting and improves conditions for fur-bearing animals as well as waterfowl. Hundreds of such structures have been constructed by land owners along the Louisiana coast for the purpose of improving marsh lands for fish and wildlife.

Potholes and ditches have been constructed in marshes to create permanent water areas and to open up dense stands of vegetation and have proven beneficial to wildlife. Although such openings may produce very little food they will attract ducks to the area and also make access easier for trappers and hunters. Ditches and potholes provide permanent water during drought periods and are particularly important to fur-bearing animals, alligators, nesting ducks and broods, frogs and small fishes, which help control mosquitoes when the marshes are reflooded. Special precaution should be taken to keep ditches from opening into tidal streams. This will result in excessive drainage of the marshes and damage to wildlife and plants.

In marshes where cattle can walk carefully, regulated grazing will open up dense stands of vegetation and create conditions favorable for ducks. As for fur-bearing animals it is generally agreed among biologists that marshes managed for maximum fur-bearing animal production should not be grazed.

However, grazing which can be controlled is usually beneficial to ducks. Not only does grazing tend to eliminate undesirable plant species from the marsh, but openings are created which will serve to attract waterfowl to the marsh area. The marsh manager who wishes to attract ducks to fresh or brackish water marshes should consider several points about grazing in the marsh. Cattle should be removed from the marsh during July, August, and September to permit desirable grasses and sedges to grow and produce seeds. Also, the marsh should be flooded from October through February with water ranging from 4 to 6 inches in depth to attract ducks and make the seeds available as a duck food.

One of the first procedures generally considered by persons wishing to improve marshes for ducks is to plant some vegetation in the marsh to produce food which will attract ducks to the area. Thousands of such plantings have been made along the Louisiana coast; however, to date there is no evidence that any planting has ever been successful in meeting this objective. Usually the absence of natural food plants in the marsh area is a result of unfavorable conditions. Consequently, the same conditions will cause the failure in any plantings made in the same marsh area. Artificial planting in the marsh can never be considered as a substitute for regulating water levels and salinities to produce natural foods. It is for this reason that persons wishing to invest in marsh management should first of all consult a specialist in this field.

Burning has been widely used along the Louisiana coast as a marsh management procedure; however, the value of most of this effort is questionable. Under certain situations burning is important for maintaining stands of vegetation. Three-cornered grass, a choice food of muskrat and blue and snow geese along the Louisiana coast, is frequently taken over by wiregrass when the two are growing in mixed stands. Burning can be used to give the three-cornered grass a head start during the growing season; however, burning alone will not maintain three-cornered grass and should not be substituted for the necessary water levels and salinities in the management of this species of vegetation or any other. Burning is important for removing dense stands of vegetation and is widely used for attracting blue and snow geese to a marsh. The geese are attracted to newly burned areas and frequently remain in the areas until the regrowth is well advanced. Also trappers find that in burned marshes walking is much easier and animals trails are much more noticeable.

Chemical control of undesirable plant species in marshes has been used on a limited basis in the past; however, in the future the marsh manager will probably place greater emphasis on this method as a tool in marsh management. Not only is land value increasing, but also more and more herbicides are being developed which can be applied to marshes at a more economical cost. As with other management techniques, a marsh manager should consult a specialist in this field before attempting wide spread applications of herbicides to the marsh.

When possible the marsh manager should give careful consideration to mineral development in the marsh. Oil and gas developments, pipelines, geophysical operations and so forth conducted in the marsh area should be closely regulated by the marsh manager and the plans for such development carefully studied by persons trained in marsh management. The damages occurring to wildlife and its habitat through the course of mineral developments can be minimized by the careful planning of such activities. Access to drilling locations involve the construction of canals and levees, and if closely regulated can often serve as a benefit to wildlife within the marsh.

Since salt water intrusion is a major problem in tide water marshes, spoil deposits should be placed so as to serve as continuous levees along the access canals. These levees should be constructed to certain specifications and the company constructing a levee should be directed to maintain them during the time they have an interest in that area. By carefully selecting channel routes water control can usually be gained over vast areas of the marsh at no expense to the land owners. Also, at strategic locations weirs or other water control structures should be placed as designated by the marsh manager. Only through careful planning and close regulation can maximum benefits to the marsh and the wildlife and fish resources be realized.

THE ALLIGATOR

By

Robert H. Chabreck and Ted Joanen

Of the many species of reptiles found in the United States, only two native representatives of the order Crocodilia exist today. These are the American alligator, Alligator mississipiensis and the American crocodile, Crocodylus acutus. Both species are found only in the Southeastern States and both occur in very low numbers when compared with past populations.

Of the Crocodilia there are four forms including the alligator, crocodile, caiman and gavial. From these 21 species are recognized throughout the world (Ditmars, 1964). In addition to the American alligator the only other member of this group is Alligator sinensis of the Yangtze-Kiang River in China, which reaches about six feet long when fully grown.

The American alligator occurs throughout all of Louisiana and Florida and inhabits parts of Texas, Arkansas, Mississippi, Alabama, Georgia, South Carolina and North Carolina. Kellogg (1929) reported that the original range extended as far north as New Jersey. Today, however, the range extends from the North Carolina coast southward along the South Atlantic and Gulf Coasts, inland to the mouth of the Arkansas River and westward to the 100th meridian in Texas. Many alligators have been reported far distant from their natural range, but they were probably purchased for pets and later released when they became a nuisance.

The ancestors of alligators and crocodiles had their origin during the Mesozoic Era some 190 million years ago. Since crocodilians were water dwellers and most sediments were laid down in water, numerous fossil remains have been located for members of this group. The typical crocodilian as we know them today emerged during the Jurassic; however, these forms, as well as those of the Cretaceous, had features more primitive than present day forms. They ranged in size from an Alligatorellus, less than one foot long, to the Phobosuchus with a 6-foot skull and a total length from 40 to 50 feet. Romer (1966) further stated that all post-Cretaceous crocodilians belonged to the Sub-Order, Eusuchia, except for a few individuals during Eocene. Members of the family Crocodylidae were abundant and of various types during the early Tertiary. The alligator as we know it today emerged in North America during Oligocene some 30 million years ago, yet described as "slightly recent".

The alligator has made history very colorful in the swampy regions of the Southeast and practically every old-timer had among his favorite tales of the past several stories about alligators. Although these tales are mostly exaggerated, they are based on fact and demonstrate how impressive the alligator really is.

Audubon (1931) in a letter written to a friend concerning the abundance of alligators in Louisiana and elsewhere in the Southeast during his exploration in the early nineteenth century gives the following account:

> In Louisiana, all lagoons, bayous, creeks, ponds, lakes, and rivers, are well stocked with them,--they are found wherever there is sufficient quantity of water to hide them, or to furnish them with food, and they continue thus, in great numbers, as high as the mouth of the Arkansas River, extending east to North Carolina, and as far west as I have penetrated. On the Red River (Louisiana), before it was navigated by steam-vessels, they were so extremely abundant, that, to see hundreds at a sight along the shore, or on the immense rafts of floating or stranded timber, was quite a common occurrence, the smaller on the backs of the larger, groaning and uttering their bellowing noise, like thousands of irritated bulls about to meet in fight, but all so careless of man, that unless shot at, or positively dis-

> turbed, they remained motionless, suffering boats or canoes to pass within a few yards of them, without noticing them in the least. The shores are yet trampled by them, in such a manner that their large tracks are seen as plentiful as those of sheep in a fold. It was on that river, particularly, that thousands of the largest size were killed, when the mania of having either shoes, boots, or saddlebags, made of their hides, lasted. It had become an article of trade, and many of the squatters, and strolling Indians, followed, for a time, no other business.

The reptile was apparently present in tremendous numbers, proving at first a nuisance to early settlers, but later providing a means of livelihood. For many years the alligators were killed to prevent destruction of livestock, for the sport of killing them, and to a small extent for their hides and flesh. Audubon (1931) also reported that oil for greasing machinery of steam engines and cotton mills was obtained from the fat of alligators. It wasn't until 1855 that any attempt was made to kill alligators in large numbers. At that time there was a demand in Paris for shoes, boots, and saddlebags, made from their hides. For a few years many thousands of alligators were killed, although the demand for hides fluctuated from year to year.

During the latter part of the Civil War, leather was scarce in the South and many thousands of alligators were killed for their hides. Also, some people to a limited extent used the flesh for food during this period, a practice which has continued to the present. When the Civil War was over, the alligators were given a short respite from hide hunters, but about 1870 it again became fashionable to have leather goods made of alligator skin. From then until the present time there has been a continuous market for alligator hides and several million of them have been marketed.

No one knows for sure just how many alligators were killed from 1870 to the present time, but the number would probably be somewhere near ten million. Smith (1891) stated that at least 2,500,000 alligators were killed in Florida from 1880 to 1893. McIlhenny (1935) estimated that from 3 to 3 1/2 million were harvested in Louisiana between 1880 to 1933. Tax records of the Louisiana Wild Life and Fisheries Commission show further that 314,404 alligator skins were sold in the state from 1939 to 1955.

So numerous were these reptiles that old hunters speak of having seen their eyes in the glare of a headlight shining on the bayou waters as thickly as the stars over head. In the spring the bellow of the males was one of the most characteristic sounds of the marsh.

Early estimates by Stevenson (1904) indicate that the number of alligators in Florida and Louisiana in 1904 was less than 20 per cent of what it had been 20 years before. In the early days of alligator hunting there were many reports of hunters taking 30 to 40 animals in a single night. Later their numbers were reduced until a take of 10 or 12 a night was considered a good hunt. In the late 1950's a successful night's hunt included the taking of two or three alligators.

McIlhenny (1935) believed that as man developed better equipment and better means of transportation, he was able to systematically exploit the wilderness areas. He listed the invention of the internal combustion engine as one of the primary factors leading to the extermination of alligators in many areas.

In the mid-1920's the vast marshes and swamps of the Southeast were trapped intensively for fur-bearing animals for the first time. Ditches were dug into remote areas, camps were constructed at strategic intervals, and a systematic harvest of the natural resources began. Fur-bearing animals were trapped in the winter and alligators hunted during the remainder of the year.

In the 1930's agriculture and industry began moving into the wetland areas. Large scale drainage was promoted by both public and private agencies, and with this the habitat began to gradually decline. Mineral exploration and development also began in a large way and brought great changes to the alligator's habitat.

In Louisiana mineral exploration crews covered every portion of the coastal marshes. These crews have been named by many as a key factor in the decline of alligators in the state. At least one man on every crew was an alligator hunter and would kill and skin the alligators as they found them along the way. When mineral development operations began, the wetland areas were cut up with a network of canals. These canals provided permanent access to the wilderness areas. Also, during extended droughts or severe floods alligators would move from the dense marshes and swamps to the canals and concentrate there. As a result they were slaughtered by night hunters. All of this was permitted by law.

As late as 1960 only two of the nine Southeastern states having alligators had suitable laws protecting them. However, by 1960 the alligator population reached a record low and it was obvious that something had to be done, or the animal would soon be nearing extinction. Over most of its original range the alligator was practically non-existent. Favorable numbers were found only on wildlife refuges and lands offering rigid protection.

In Louisiana, one of the alligator's havens of the past, the valuable reptile had practically been exterminated and in 1963 the Louisiana Wild

Life and Fisheries Commission closed the season on alligators and made it illegal to kill or molest alligators anywhere in the state. The only persons allowed to have alligators in their possession were licensed alligator breeders.

Nesting and Breeding Habits

The alligator breeds when about 6 feet long, which is usually when they are 5 years old. All mature female alligators from the Sabine National Wildlife Refuge in Cameron Parish examined by Giles and Childs (1949) before May 26 had eggs in the ovary; all examined during June had well-developed eggs with shells in the oviduct. Accordingly they give the following schedule of reproduction:

April-May----------Maturation of eggs in ovaries.
Mid-May--Mid-June---Ovulation and mating.
Mid-June--Mid-July---Nest building and egg laying.
Mid-August--Mid-September---Hatching of young.

McIlhenny (1935) reported that all nests with freshly laid eggs were found between May 20th and June 25th. He found the incubation period to be nine weeks.

The female bites off vegetation to build the nest and piles the litter in a cone shape mound. The nest which is usually constructed along a stream bank or in a shallow water marsh is variable in size, averaging 5-7 feet at the base and 2 1/2 - 3 feet in height. From 20-75 eggs are laid in a mass within the nest and the female covers them with vegetation and mud. The eggs are white with a diameter similar to that of a chicken egg but they are longer and have rounded ends.

The young are equipped with an egg tooth to aid in breaking the shell when hatching. Once out of the shell they make a grunting sound, then the female removes the upper part of the nest and frees the new arrivals. The young live on the yolk of the egg for the first few days of life. The average size of the young at hatching is 8 to 9 inches in length and 2 ounces in weight. They remain in the vicinity of the nest throughout the first year. During the early period of the alligator's life it is vulnerable to various predators such as herons, large fish, turtles, raccoons, snakes and other alligators that might happen by. Only a small percentage of the young reach maturity; however, after reaching 3-4 feet in length they have few enemies except man.

Food

The food of alligators depends largely on what is available in the area. Mature alligators will feed on almost anything they can find in or near the water including: crayfish, crabs, snakes, turtles, birds, muskrats, raccoons, rabbits, pigs, garfish, other fish types, young alligators, and many other forms of animal life. Alligators feed at every opportunity during the warm months but rarely accept food from October to April.

Young alligators feed largely on insects, frogs, crayfish, and crabs for the first few years of their life. As they get larger, the portion of invertebrate food in their diet decreases and the amount of vertebrate food increases. The alligator swallows its food whole without chewing it. Powerful digestive juices enable them to digest turtle shells, bones, or the like.

Habitat

In Louisiana alligators were originally found in all of the lowlands of the state including the rivers, creeks, bayous, lakes, ponds, and in either fresh or salt marshes. They could be found in any water area where sufficient food existed. Today, due to heavy hunting pressure, they occur in large numbers only in the more inaccessible areas such as the coastal marshes, the Atchafalaya and other large swamps. There are still a few alligators in some of the smaller inland streams and lakes.

McIlhenny (1935) states that the alligator can live for months without water but are very discontent and will eventually move to areas with water. Alligators need water so that they can construct a den for winter hibernation. The dens vary in size but may be as much as 40-60 feet in length. Large alligators begin the construction of the dens in September and hibernate in October or November. The dens are occupied as long as the water is warmer than the air. Frequent visits to the surface are made in bright warm days during the winter months; however, the alligators do not feed at this time.

The number of alligators which can live in a particular area depends upon the food available and the size of the alligators. A marsh area along the coast would probably support one alligator for each 5 to 10 acres. A sandy creek may support no more than 2 alligators per mile, while in a swamp it may take 20 acres to provide enough food for an alligator.

Movement

From 1959 through 1965, 2,024 alligators were captured, marked and released in Southwestern Louisiana. The alligators were captured on Rockefeller Wildlife Refuge and Sabine National Wildlife Refuge. The data from tagged animals plus numerous observations on the refuges provided information on movement and growth.

Movement was greater among immature alligators (less than 6 feet long) than adults. However, no difference was noted in the movement of tagged immature alligators from 2 to 6 feet long.

Tagged alligators captured and released at the same site moved farther and farther from the site as time progressed. Of those recaptured after 3 years, 67 per cent dispersed over one mile from the release site.

The factors having an effect on natural movement were temperature changes, the breeding season, high water conditions, drought, food supply and water salinity.

Tagged alligators transported elsewhere for release moved 3 to 4 times greater than normal and showed strong homing instincts. Of those recaptured 2 years or more after release, 83 per cent had dispersed 8 miles or more from the release site.

Growth and Longevity

The growth rate in young alligators is influenced to a great deal by the amount of food consumed. Since they feed only during the warm weather months, growth occurs at this time. During the peak growth periods alligators were measured which were growing as much as 4 inches in length per month. However, such growth does not take place over a very long period and averages only about 1 foot per year and only for the first 4 or 5 years of life. Afterwards, the growth rates decline continuously until the animal reaches about 11 feet in length with a weight of approximately 350 pounds, at which time growth becomes very slow. Female alligators are rarely found longer than 9 feet.

Early records indicate that alligators were found in Louisiana ranging upward to 19 feet long. Today animals greater than 10 feet long are very unusual; although there are a few remaining which will measure about 14 feet in length. The age of a 10 foot alligator is probably 15 years at a minimum and could extend upward to 100 years.

What will happen to the alligator in the future? That's the big question now. We know very well how to rebuild alligator populations, because we have seen it demonstrated so clearly in certain areas. We know that progress has been made in the past few years, but we must be persistent to make sure that it continues.

Additional legislation is badly needed to fill certain loopholes in existing laws. It is essential that federal laws be passed or amended to prohibit the transporting of illegally taken alligators or alligator skins from state to state. Also, state laws are needed to strengthen the position of landowners managing marshes for alligators. The landowner should benefit from future alligator seasons through special alligator tagging systems or licenses.

There is considerable interest at present in alligator farming. However, sufficient evidence is not yet available to prove that the reptiles can be raised in pens on an economically sound basis. Nevertheless, experiments now underway by the Louisiana Wild Life and Fisheries Commission show favorable results. If suitable alligator farming practices can be perfected, then a supply of skins to meet the industrial demand can be produced by these means.

More information is needed on the habits and basic requirements of alligators. Louisiana has done a great deal in alligator research over the past 10 years, yet much remains unknown. A continuation of this research work is essential with special emphasis in the future placed on determining habitat requirements and ecology of the reptile. As the wetland habitat continues to give way to agriculture and industry, more intensive management of the remaining wetlands will determine the success of the alligator's future.

Enforcement will be as important in the future as it has been in the past. Without adequate enforcement, laws and regulations are useless. Whenever the welfare of a resource is in jeopardy, most people are honest enough to abide by laws set up to protect the resource. However, a few people are not and without adequate enforcement, by the courts as well as game agents, this small segment of violators will continue to operate. Then in reality all you will have is a private hunting club for the lawless element. Therefore, in planning for the future of the alligator the importance of a rigid, well-coordinated enforcement program must be emphasized.

LITERATURE CITED

Audubon, J. J. 1931. "Observations of the Natural History of the Alligator." Louisiana Conservation Review. 2(3):3-8.

Ditmars, Raymond L. 1964. Reptiles of the World. The Macmillan Co., New York. 321 p.

Giles, Leroy W. and Childs, V. L. 1949. "Alligator Management of the Sabine National Wildlife Refuge."Jr. Wildlife Management. 13(1):16-28.

Kellogg, Remington. 1929. "Habits and economic importance of Alligators." U. S. Dept. Agr. Tech. Bull. 147:1-36.

Louder, D. E. 1965. "The Alligator, North Carolina's Link With the Past." Wildlife in N. C. 29(8): 4-6.

McIlhenny, E. A. 1935. The Alligator's Life History. The Christopher Publ. House, Boston. 117 p.

Romer, Alfred S. 1966. Vertebrate Paleontology. The Univ. of Chicago Press. 468 p.

Smith, H. M. 1893. "Notes of the Alligator Industry." Bul. U. S. Fish Comm. (1891) 11:343-345.

Stevenson, C. H. 1904. "Utilization of the Skins of Aquatic Animals." U. S. Comm. Fish and Fisheries Rpt. 1902:281-352.

LOUISIANA SQUIRRELS

By

J. B. Kidd

SPECIES AND RACES

Nature not only provided Louisiana with an abundance of squirrels, but also added interesting races of this important game animal that inhabit the states varied habitat types. Three races of fox squirrels and 2 gray races have been defined within Louisiana's boundaries with each specific race confined to distinct habitat types.

Fox Squirrels

Peculiar to the southeast Louisiana terrace lands, where great stands of virgin long leaf pine at one time existed, is the white nose fox squirrel or Bachman's fox squirrel. This animal displays a rust colored body with white markings covering the nose, ears, toes and tip of tail. Records of this squirrel west of the Mississippi River are not known. Apparently the Mississippi River and bordering swamp lands prevented spreading of the race to similar habitat in western Louisiana. The melanistic phase of this squirrel is rare, but it does occur and if you are not fortunate enough to see this color phase in the wild, specimens may be seen in the Louisiana State Museum of Natural History in Baton Rouge.

A second race of fox squirrel exists in the northwest Louisiana uplands and the southwest Louisiana terrace lands and is the home of Louisiana's largest fox squirrel. Trapping records revealed that some specimens weighed as much as 2 1/2 pounds. This robust animal is grayish above, strongly suffused with black, buff and pinkish cinnamon below. The black phase also occurs in this race and is commonly found.

The western race appears to be more at home on the ground, than the other two, and it survives in the cutover sections of the state in scrubby black jack-post oak types miles from large timber.

The hardwood bottoms of the Mississippi, Atchafalaya, Red and Ouachita Rivers are the home range of the delta fox squirrel, the last of the three fox squirrels found in Louisiana. This animal is closely associated with hardwoods and it is not commonly found in the pine lands. Unlike its two larger relatives it may be found deep in the hardwood swamps and does not necessarily require the more open forest or woodland edges. It is found in abundant numbers in the previously large overflow areas of the state. Before levees were erected along the main river channels this animal no coubt spent a good portion of its life over water in the giant cypresses, tupelo gums and water hickories. The melanistic phase of the delta fox squirrel is much more prevalent than in the other two races. During the process of making squirrel hunter bag checks in lower Concordia Parish in 1952, it was noticed that nine out of every ten fox squirrels examined were black in color. In 1954 along the Atchafalaya River in Pointe Coupee Parish about 50 percent of fox squirrels examined in a bag check operation were of the black phase. Yet in examining 40,000 animals from a study area in St. Landry Parish over an eight year period, 1958-65, not one black fox squirrel was recorded! The reason why some areas produce black and red animals in varying degrees of abundance is a mystery of nature which is not yet understood. It has been observed by the writer that on the western and eastern extreminities of its range, the black phase is less common. As one penetrates the great river swamps, especially the areas that once overflowed, the proportion of black animals seems to increase.

Because of the geographic location of the delta fox squirrel whose range is flanked by the other two races there is a zone of interbreeding where the ranges overlap. The offspring between these crosses produce various shades of brown and red. Cinnamon and mink colored animals have been recorded in this zone of integration.

Gray Squirrels

The gray squirrel does not display the handsome color pattern of the fox squirrel, but of the two species it is by far the best tree top aerialist. Its gray coloration also makes it harder to see and it can literally vanish in front of your eyes.

There are two races of gray squirrels which inhabit the state - the southern gray squirrel and the bayou gray squirrel. The southern gray squirrel is common throughout the entire state. It is found along streams in river bottoms and swamps. The bayou gray squirrels occur along the Atchafalaya River and the lower Mississippi River and bayous of south Louisiana. The bayou animal differs from the other race in that it is a dark, almost brown animal. The under parts are usually tan or brown as compared to the white belly of the southern gray. Interbreeding occurs where the ranges of the two races overlap.

If one encounters squirrels where there is doubt about species identification one way to determine the mystery is to cook the animal. The bones of the fox squirrels are redish pink as compared to the white bones of gray squirrels. An examination of the dental formation may also help in verifying species in question. The gray squirrel has five teeth on each side of its upper jaw as compared to four in the fox squirrel.

LIFE HISTORY AND HABITS

Tree squirrels belong to the large family of gnawing rodents, Scuridae, which also includes the marmots, woodchucks, prairie dogs, ground squirrels and chipmunks. They are characterized by having two incisors above and below with a distinct space between the cutting teeth and the grinding cheek teeth. Squirrels also have four toes on the front feet and five on the rear.

Of the many species found within the large squirrel family only two species, the fox and gray species, are sought after by hunters as game species. The gray squirrel is a product of large unbroken heavy forest while the fox squirrel normally inhabits the edges and open types.

Breeding Dates and Litters

By late December and early January the rutting parties begin to appear. These frenzied chases may last for several hours until the female is bred, usually by an older male. The peak breeding period occurs in late winter followed by a smaller one in July. Pregnant females, however, have been collected every month of the year. It is from this late winter mating that spring litters will emerge to furnish the bulk of the fall population for hunting. Summer litters are born in July and usually make up a smaller portion of the fall population. During poor mast years females may skip bearing young in the spring and may bring off their litter during the summer. It is only during these poor mast years that the summer litter may be important.

Fox Squirrels

Date Season Opened			Spring Born	Summer Born
		Percent	83.5	16.5
Oct. 1	1955-56	No. Examined	602	119
		Percent	84.7	15.3
19	56-57	No. Examined	447	81
		Percent	88.1	11.9
18	57-58	No. Examined	844	114
		Percent	87.3	12.7
1	58-59	No. Examined	117	17
		Gray Squirrels		
		Percent	65.6	34.4
Oct. 1	1955-56	No. Examined	21	
		Percent	54.8	45.2
19	56-57	No. Examined	264	217
		Percent	73.2	26.8
18	57-58	No. Examined	71	26
		Percent	68.3	31.7
1	58-59	No. Examined	110	51

After mating it takes approximately 42 days of gestation before the infant animals are born. Young squirrels are born blind, naked and helpless and the average litter size of both fox and gray squirrels is two or three animals. Litter size of four are not too uncommon, but anything exceeding this number would have to be considered exceptional. Placenta scars were examined and embryo counted from 58 females collected in 1953-54 and 55 revealed an average litter size of 2.7 gray squirrels and 2.6 for the fox species. A total of 23 gray squirrel litters was checked in nest boxes from February 28 through October 23, 1957. Fourteen litters were considered to be spring born animals compared to 9 that were born in late summer. The average litter size of all litters examined was 2.4 young.

The parent female cares for her young until they are able to live on solid food alone which is about 8 weeks of age. She is a watchful mother and will move her young from one nest location to another if disturbed continually. It was noticed while examining litters in nest boxes if the young were handled too much the infant squirrels were moved by the adult.

Nesting Sites

The rearing sites of young squirrels are hollow trees and leaf nests. Of the two, tree hollows are by far superior, offering more safety and protection from the elements. However, in the cutover forest of the state, hollow trees are somewhat scarce and the majority of the squirrels are born in leaf nests.

Most squirrel managers have, at one time or another, tried the use of nest boxes in an effort to provide safer rearing nests and thereby increase the squirrel population. Squirrels will use den boxes, but in no case has the squirrel population ever been materially increased with their use.

In 1954, 200 squirrel boxes were erected around farm sites in Louisiana. There were very few litters reared in these boxes with only four verified litters actually having been checked. Nest boxes examined in Louisiana revealed that bees, wasps, flying squirrels and screech owls were the main inhabitors of the boxes. Squirrels will apparently use these artificial dens if they can occupy them before their competitors arrive. This may be a good practice in small wood lots where not too many boxes are involved and can be kept free of undesirable competitors until occupied by squirrels.

Habitat Preferences

The gray squirrel is the product of heavy unbroken forest. A thick understory of smaller trees, shrubs and numerous vines is preferred. Cat squirrels are constant users of the thick understory and often feed in the lower canopy on berries and fruit of the smaller woody species.

Fox squirrels generally prefer the open forest or wood lots. The formally large overflow areas of the state which left clean forest floors after the drawdown were principally occupied by the delta fox squirrels. Large numbers of these acres were once occupied by two major tree species-bitter pecan and overcup oak. Gray squirrels were usually absent from this type habitat.

It has been noticed that forest conditions may be influenced such that the species of squirrels inhabiting the area may be switched. The introduction of large numbers of cattle in a gray squirrel woods may decrease the gray squirrel population and increase the number of fox species present. This will occur as cattle will tend to clean and open up the forest floor thereby making the area attractive to fox squirrels. Going to the reverse procedure, a fox squirrel woods may revert to gray squirrels if logging occurs. This operation will allow new undergrowth on the forest floor to sprout which is conducive to increase gray squirrel populations.

There are areas where habitat conditions are such that both fox and gray squirrels will live in a compatable relationship. This occurs quite frequently in the upland of the state where hardwood creek bottoms run through a pine forest. Gray squirrels will be prevalent in the creek bottoms with fox squirrels occurring in smaller numbers along the edge of the bottoms where the pine stands begin. Along the "field edges" of large hardwood blocks you may find fox squirrels while only 200 to 300 yards deep in the area, gray squirrels are numerous.

Where fox and gray squirrels intermingle they will share the same feeding trees. On two occasions the author has killed both fox and gray squirrels out of the same tree. On one occasion the feeding tree was a sweet pecan and on the second incident a bald cypress had attracted both species. It is doubtful if the two species would share the same tree for rearing young.

Movements

The home range of both fox and gray squirrels is usually restricted to a small number of woodland acres. Hunter tag return information has shown some instances where squirrels have moved distances as much as 8 or 9 miles, but this is an uncommon occurrence. Records of retrapped gray squirrels from a 10,000 acre study area in St. Landry Parish in 1961 show an average distance of movements as being 220 yards. This data was determined from 51 gray squirrels which had been retrapped one or more times. Of these 51 animals eight were trapped at least twice or more in the same trap. The longest movement recorded was 1,210 yards. There was one animal which was retrapped eleven times in a period that spanned from July to October. This particular animal was retrapped in two traps spaced apart at a 55 yard interval. As far as could be determined no animals moved off the 10,000 acre area.

Each year while talking to hunters the question of migration is brought up. This unusual mass movements of squirrels, which should truly be called an emigration, occured in the late 1700's or early 1800's and were the result of large population buildups in the extensive natural hardwood forest that covered the eastern half of the United States.

The exact reason why these movements occurred is not fully understood. In some cases the exodus may have occurred where food was present in abundant quantities. Perhaps the emigrations were motivated by sheer over-crowded conditions.

The great emigrations of the past are non-existent today and it is doubtful that they will ever appear again. Our present cutover forests no longer have the capacity to produce mammoth populations which were associated with the great emigrations of the virgin hardwood stands.

Food Habits

Squirrels by nature are hard nut eaters. Nature has provided them with central cutting incisors that are capable of gnawing into the cores of the toughest hickories, pecans and walnuts. As a matter of fact squirrels have to chew on hard surfaces regularly to keep their continually growing incisors worn down for proper occlusion.

Louisiana offers a variety of squirrel foods and beginning in August sweet pecan, pignut hickory, mockernut hickory, hackberry, sweet gum and muscadine are prevalent foods. By September acorns of water oak, willow oak, white oak, nuttall oak, shumard oak, cherry bark oak, American beech, blue beech, tupelo gum, cypress, black gum and the fruits of black jack vine and poison ivy are in full production to give the fall squirrel population a bountiful and varied food supply.

Sound acorns which become buried in mud or covered by water will remain good until the summer and become readily available during dry periods. It is not uncommon to see where squirrels have dug up acorns in July and August that had been buried in the previous winter.

During the early spring months squirrels consume large quantities of buds from maple, elm, ash, and other green material. In May and June mulberry and wild cherries are preferred food when found. Squirrels will also eat pine cones in June and July when other foods are scarce.

Squirrels will supplement their vegetative diet by eating small quantities of bone material, deer antlers, and sometimes the eggs of bird nests are consumed. Grubs and larvae are eaten during the summer months as there seems to be a need for the protein content.

During peak populations in cities and towns squirrels may become destructive, raiding pear, plum and fig trees. In July of 1966 a wildlife agent trapped and removed fifteen fox squirrels from an Iberville Parish resident's tomato patch. General reports are received from the town of Lafayette which state that squirrels eat the buds of japonicas, azaleas, and other shrubbery.

While free water is not a necessary requirement in squirrel diet, it is taken readily during extended dry periods in late summer. It is believed that, during the hot summer months, squirrels without access to water will turn to eating succulent vegetation to satisfy their moisture requirements. Perhaps this is why the fox squirrels visited the tomato patch which was discussed in the above paragraph. The author once observed a fox squirrel that ate large quantities of St. Augustine's grass daily. This occurred several days in succession during a dry period in August. After a rain broke the drought the animal discontinued this practice.

Sex Ratios

It has been noticed while doing squirrel bag check work in the fall that distortions in sex ratios seem to be the rule rather than an even proportion of sexes. From a study where data have been collected over an eight year period noticeable uneven sex ratios existed six years out of eight in both fox and gray squirrels.

From figures collected it was found that during the peak hunting years of 1960 and 1962 the sex ratios of gray squirrels were nearly even. In 1962 there were a total of 2573 male grays examined as compared to 2554 females. In 1962 the figures revealed that 2508 males were killed along with 2548 females. Following these peak years the squirrel population declined and an excess of males appeared in the hunters' bags. This was especially noticeable in 1963 which was the lowest ebb of the squirrel population on the area during the eight year period. At this time hunters bagged 1141 male gray squirrels and 895 females. Previous to the buildup in 1960 an excess of females existed.

These figures from the gray squirrels examined may show patterns toward the following tendencies. As the population builds an excess of females may exist; during the peak years the ratios between the sexes are nearly even; and as the population declines after a peak year the sex ratios favor males.

St. Landry Parish
Fall Sex Ratios
All Age Classes

	Fox		Gray	
Year	Male	Female	Male	Female
1958	271	291	2330	2690
1959	212	244	2241	2484
1960	352	294	2573	2554
1961	255	284	1973	1863
1962	446	430	2508	2548
1963	194	178	1141	895
1964	227	251	1888	2053
1965	249	275	1528	1712
Totals	2206	2247	16182	16999

Emasculation

Some of the old timer squirrel hunters still express the belief that old male squirrels cut the young ones to thin out competition for the females. Each year some hunters will swear they have killed males that have been castrated.

This fact, as yet, has never been authenticated. Since 1954 Louisiana Wild Life and Fisheries technicians have examined 110,000 squirrels from all sections of the state. Approximately half of the animals were males and yet not one true case of emasculation has ever been recorded.

This myth is prolonged each year when hunters find young developing males whose testicles have not yet descended into the scrotal sac. It is normal for male squirrels to retain their testicles in a receded condition until they have reached breeding age at which time the testicles will enlarge and descend. The scrotal sac of young males is also covered with hair which further makes the presence of the testicles obscure. It has also been noticed that adult squirrels which have been shot in the scrotum may have receded testicles due to the natural reflexes of the animal. In each case where alleged emasculation was reported to the author a quick incision in the scrotum has disclosed the presence of testicles and has satisfied the hunter's curiosity.

Life Span

Like most rodents squirrels have relatively short lives in the wild state. Research information gathered over a period of years revealed that a large replacement in the squirrel population occurs each year regardless if it is hunted or not. This data further points out that most squirrels will not survive past the second year and that the maximum life expectancy in the wild is 5 1/2 years.

A five year study on the Thislethwaite Wild Life Management Area shows that hunters averaged killing 30 percent of the fall population with natural mortality that was equal to or exceeding hunters total kill. Tag return information gathered shows that of 93 squirrels that were trapped, marked and released in August and Septmeber of 1961, 35 were killed by hunters in October of 1963, 3 lived until October of 1964 and one was killed in October of 1965, 4 years and two months after initial marking. This longevity record of 4 years is the longest authentic record on hand for the state. There are records, however, of captive squirrels that have lived as much as 10 years.

MANAGEMENT

The shotgun may at times be a suitable method of reducing game population, but its effect is minute when compared to the power saw, the bulldozer and the modern farm implements now used. The hunter and shotgun have been unjustly blamed for decimated game populations while in actuality the large scale changes in habitat are the lasting detrimental factor.

Modern wildlife management programs are set up on a principle which is aimed at allowing the hunter to harvest the surplus increment of the animal population. In some instances the surplus may be realized by the hunter, but in small game populations, and especially where squirrels are concerned, legal hunting usually results in an under harvest with gunning having little effect on future populations.

Since it is impractical to manipulate habitat or make food plantings to benefit squirrels the wildlife manager must wisely apply his most important tool of management to the squirrels - hunting pressure. The effects of hunting pressure, seasons, bag limits, population densities, and fluctuations are all intregal parts of management which must be fully understood in order to promote a sound wildlife program.

The Effects of Hunting

Two studies have been carried out in the state which measured the effect of gunning on the fall squirrel populations. One of these areas is located in Grant-Rapides Parish and the other in St. Landry Parish. The areas are 7,000 and 10,000 acres in size respectively and both are pure hardwood bottom types. The Grant-Rapides area is principally fox squirrel habitat as compared to a gray squirrel woods in St. Landry Parish. This research program involved the trapping and marking of squirrels with subsequent hunter tag returns used in computing the percent of the total population removed.

On the Grant-Rapides area during the years 1957, 1958, and 1959 a total of 396 marked squirrels were available to hunters when the respective seasons opened. During this three year period a total of 3,187 hunting efforts were made which resulted in killing 5,404 squirrels. Tag return information from these three years of hunting show that hunters annually harvested 15 percent of the total population. During this period the return information didn't vary over one percent which shows that percent hunters harvested of the total population for all three years was nearly equal.

Grant-Rapides Squirrel Kill Information - 6000 Acres
Half-day Hunting Only

Year	No. Days Hunted	No. Hunts Made	Total Kill	% of Population Killed by Hunters	Estimated Population
1957	14	1410	2445	15.6	15,600
1958	10	757	1059	14.0	7,564
1959	10	1020	1901	15.5	12,200

The Thistlethwaite Game Management Area in St. Landry Parish was also subjected to a trapping and marking program through the years 1961-65. This research study resulted in the trapping and marking of 793 squirrels which were available to hunting. During this period hunters averaged killing 30 percent of the annual fall population. This figure in hunter harvest varies from a low of 21 percent in 1964 to a high of 40 percent in 1962.

Thistlethwaite Game Management Area - 10,000 Acres
Squirrel Kill Information
Half-day Hunting Only

Year	No. Days Hunted	No. Hunts Made	Total Kill	% of Population Killed by Hunters	Estimated Population
1961	16	1819	4376	37.6	11,200
1962	19	2243	5932	40.5	14,300
1963	25	1574	2408	26.7	8,300
1964	25	2168	4419	21.2	21,200
1965	25	1923	3764	29.5	13,000
1966	25	1425	1658	None made	None made

Further bag check data gathered throughout the state has also shown that squirrel populations in the face of continuous heavy gunning will hold its own and show increases when food conditions are favorable. This additional data was gathered from ten wildlife management areas (other than Thistlethwaite and Grant-Rapides) during the period 1954 through 1960. During these years wildlife technicians checked and examined over 32,000 hunters which had killed in excess of 95,000 squirrels. This bag check information points out that all the areas in 1960 experienced hunting success that was equal to or exceeded any previous year's hunting.

It is therefore concluded that legal hunting in no way endangers or curtails future squirrel populations. It is further believed that an annual harvest of 30 percent of the state's total population would be a maximum figure.

Bag Limits and Seasons

Louisiana has traditionally had a long squirrel season with a relatively large bag limit. During the past 20 years Louisiana's squirrel season had run roughly for a 3 month period with bag limits varying from a low of 6 to a high of 10 daily. For the past 6 consecutive years, 1960-66, the bag has been 8 daily with the season opening on the first Saturday in October and extending through January 10. This current trend seems to satisfy most hunters and is biologically sound as well.

While a large bag limit of squirrels is available to hunters annually, the average take per hunting trip throughout the state is considerably lower. During the 1953-54 hunting season 1352 bag checks were made in 19 parishes of the state. These hunters killed 2497 squirrels for an average kill per hunting trip of 1.9 squirrels. During the 1954-55 season 1877 hunters averaged killing 2.7 squirrels per trip; in the 1955-56 season 1418 hunters checked had killed an average of 1.7 squirrels per hunt; the 1956-57 season revealed that 2164 hunters averaged killing 1.6 squirrels per hunting effort; and during the 1957-58 season 844 hunters bagged an average of 1.7 squirrels per trip. In addition to these state-wide averages, game management area hunts from 1954 through 1965 show hunters averaged killing about 2 squirrels per hunting effort. This figure was determined from making more than 50,000 individual hunter bag checks on controlled managed hunts where every person's bag is checked at the completion of each hunt.

The above data clearly demonstrates that the size of the bag limit has little to do with the hunters average kill. Hunters may boast of their ability to kill squirrels, but in actuality they are relatively few who are able to kill a limit of 8 squirrels. Very accurate records were kept on 16,811 bag checks in the Thistlethwaite G. M. A. from 1958-1965. This data shows that only 4.2 percent of the hunting efforts resulted in limit kills. Further information shows that 27 percent of hunters didn't net a single squirrel (See table below.); and it is further demonstrated that 75% of the hunts resulted in netting 3 squirrels or less!

Hunter Success Classes
16,811 Bag Checks
Thistlethwaite G.M.A. - 1958-1965

Percent	Hunters	Killing	0	Squirrels	-------------------	27.2
"	"	"	1	"	-------------------	20.1
"	"	"	2	"	-------------------	16.0
"	"	"	3	"	-------------------	11.6
"	"	"	4	"	-------------------	8.2
"	"	"	5	"	-------------------	5.4
"	"	"	6	"	-------------------	4.8
"	"	"	7	"	-------------------	2.5
"	"	"	8	"	-------------------	4.2

Considerable controversy exists among hunters concerning opening dates of the squirrel season. Collected information shows that the squirrel population reached its peak during early October and squirrels are easier killed at this time of year than any other. It is realized that some infant animals may still be nursing at this time, but a delay until late October will only serve to increase the already inadequate harvest of the state's squirrel population.

The early October season allows hunters to still hunt while the squirrels are feeding in the trees; it is during this time that the bulk of the season's squirrel kill is made (75%-80%). A delay in the opening date will allow more natural mortality to occur and deprive hunters of better success. When all factors are weighed carefully it is both logical and biologically sound to open Louisiana's squirrel season in early October. The pattern set by the Louisiana Wild Life and Fisheries Commission during recent years is to open the season the first Saturday in October. This weekend beginning gives most hunters an equal opportunity to bag a few bushytails before they become too wild and hard to harvest.

The length of the squirrel season is usually allowed to extend through the tenth of January. This season is purposely allowed to extend into late winter to benefit the hunter who likes to use dogs while hunting squirrels. During December and January ground feeding squirrels may be easily found with a dog. There is some opposition to the use of dogs by "died-in-the-wool" still hunters. Those opposing the use of dogs may think that squirrel hunting at this time of the year is a serious detriment to future populations. It is granted that females are beginning to breed at this time and pregnant animals may be found in the population. But the kill of the dog hunter is negligible where the overall population is considered. A total of 3229 bag checks made in the field in 1954 and 1955 show that only 3.5 of the hunters owned squirrel dogs. There has been no conclusive proof that dog hunting caused any serious detrimental effects on future squirrel populations. Since it is the responsibility of the Wild Life Agency to provide as much hunting recreation as possible to hunters, dog hunting will continue as long as undesirable effects cannot be measured.

Population Densities and Fluctuations

For every squirrel the average hunter sees there is probably 8 or 10 that he wasn't able to detect. Some hunters have very keen outdoor senses and are very successful in finding squirrels while ability may be poor. This fact should always be kept in mind when interviewing hunters about squirrel populations and densities.

If 10,000 acres of Louisiana woodland supported an average of 2 squirrels per acre, this would have to be considered a high squirrel population. This figure is based on data from a 10,000 acre study area of excellent squirrel habitat where population estimates were computed from tag return information and compared with hunting success.

On the Thistlethwaite Wildlife Management Area, where this study was conducted, it was determined that during the 1962 fall season 1 1/2 squirrels per acre existed on the area. Hunter success in 1962 was the highest of all years hunting on the area during the hunting years 1958-67. The harvest of squirrels per acre in 1962 was computed at one animal for every 1.5 acres of woodland. The total kill in 1962 was 5932 squirrels with hunters averaging a kill of 2.6 squirrels per hunting effort. In 1963 the squirrel population took considerable drop as the population density dropped and was estimated at 0.8 of a squirrel per acre. Hunters in 1963 harvested one squirrel per 4 acres and the total kill realized was 2408 squirrels. The average kill this year was 1.5 squirrels per hunting trip.

During the 1964 and 1965 hunting season the population of squirrels showed increase over hunting in 1963. It is believed that hunter success and total kill would have been considerably greater, but two hurricanes on succeeding years greatly hampered hunting. In 1964 the storm passed through the area on the opening weekend and in 1965 the hurricane struck the area two weeks in advance of the opening date.

The effect of hurricanes on squirrel population is not fully understood but it is a known fact that after two successive hurricane years and poor mast production the squirrel population showed a big decline. During the 1966 year the squirrel harvest on Thistlethwaite dropped drastically and showed its lowest yield during the 10 year period 1958-1967.

The total kill in 1966 resulted in 1658 animals harvested or an average kill of 1 squirrel per 6 acres. Following the 1966 kill a classic recovery was witnessed in the squirrel population. The kill jumped from 1658 animals in 1966 to 4991 in 1967!!! This was an increase in total kill of approximately 300 percent and demonstrates the biotic potential that exists in squirrel populations.

There are other interesting kill figures that occurred on the various wildlife management areas scattered throughout the state. The largest kill ever recorded came from the West Bay area in 1961. During a 21 day season hunters killed 10,018 squirrels from this 56,000 acre area. The following year the kill was dropped to 7,404 squirrels. This drop did not reflect a reduction in population as the average kill was equal. The total kill declined because the number of hunters participating dropped approximately 1,000.

The best production yield on a per acre basis occurred on the Grant-Rapides WLMA in 1955. From this 6,000 acre bottomland area a total of 5,281 fox squirrels were killed. This represents a harvest of 1 squirrel per 1.1 acres.

Some of the poorer squirrel areas in the state reveal figures that range from a low of 1 squirrel per hundred acres to a squirrel killed per 18 acres. This data just mentioned was determined on the Evangeline WLMA from the years 1954 through 1960. This area lies in cut over pine type and is classed as poor squirrel habitat. The Red Dirt area is another pine type which showed poor success during the one year it was opened. This area, 36,000 acres in size, yielded a kill of 252 squirrels in 1955.

One may ask the logical question: "Why do squirrel populations fluctuate?"

Population densities are related to food supply. In years of abundant food, squirrels survive the winter well and bring forth good reproduction the following year. During poor food years, the survival rate is reduced and reproduction is lowered.

FUTURE OUTLOOK

From 1962 through 1968 it is estimated that 1,000,000 acres of hardwood forest have fallen before the cutting blade of the land clearing bulldozer. These valuable wildlife forest lands were capable of supporting 1,000,000 squirrels - a million squirrels that could have been available to Louisiana hunters - a million acres that would have also supported deer, rabbits and hundreds of species of wild birds and other mammals - a million acres of wildlife habitat lost forever.

A hunter mail questionnaire report conducted by the Louisiana Wild Life and Fisheries Commission showed that 157,801 squirrel hunters killed 2,800,000 animals in Louisiana during the 1967-68 season. While it appears that there is no great immediate danger of squirrels becoming extinct in Louisiana it is significant to point out that present land clearing practices adjacent to out great river systems are reducing the restricted range of the delta fox squirrel considerably. If present clearing practices continue it is conceivable that this particular race of fox squirrels could be reduced to critically low numbers or vanish completely from our forest. Let's hope not!

Squirrel hunting, according to the 1967-68 mail survey, is still the number one hunting sport in Louisiana. Let's hope that it will always remain as such and that present trends in land clearing hardwoods will be reversed by greater demands for hardwood products and the ever increasing number of Louisiana hunters.

SQUIRREL HUNTER SUCCESS
LOUISIANA GAME MANAGEMENT AREAS
1954-67

Area	Year	Date Season Opened	Bag Limit	No. Days Opened	Total Hunts Made	No. Squirrels Killed	Av. Kill Per Hunting Effort	Size Area In Acres
Livingston	1954	10-1	8	15	821	1906	2.3	
	1955	10-1	10	15	1072	1962	1.8	
TOTAL					1893	3868		
Catahoula	1954	10-16	8	7	1800	2966	1.6	
	1957	10-18	10	14*	807	1428	1.8	
	1959	10-17	6	5*	438	1105	2.5	
	1960	10-1	8	5*	866	2597	2.99	
TOTAL					3911	8096		36,000
Evangeline	1954	10-1	8	15	868	867	.9	
	1955	10-1	10	15	230	249	1.1	
	1957	10-18	10	14*	200	228	1.1	
	1958	10-1	8	3	179	135	.75	
	1959	10-17	6	3	176	207	1.10	
	1960	10-1	8	4*	138	160	1.16	
TOTAL					1791	1846		15,000
Union	1955	10-1	10	15	241	528	2.2	
	1957	10-18	10	14	202	410	2.0	
	1958	10-4	8	7	178	343	1.92	
	1959	10-17	6	14	279	667	2.39	
	1960	10-1	8	16	400	1090	2.71	
TOTAL					1300	3038		12,000
West Bay	1955	10-1	10	15	1918	3607	1.9	18,000
	1960	10-1	8		2448	4922	2.0	
	1961	10-7	8	21	4406	10018	2.27	
	1962	10-6	8	23	3293	7404	2.26	
TOTAL					12055	25951		56,000*
Grant-Rapides	1955	10-1	10	15	2540	5281	2.1	
	1957	10-18	10	14*	1410	2445	1.7	
	1958	10-1	8	10*	757	1059	1.39	
	1959	10-17	6	10*	1020	1901	1.86	
TOTAL					5727	10686		6,000

SQUIRREL HUNTER SUCCESS
LOUISIANA GAME MANAGEMENT AREAS
1954-67 (cont'd)

Area	Year	Date Season Opened	Bag Limit	No. Days Opened	Total Hunts Made	No. Squirrels Killed	Av.Kill Per Hunting Effort	Size of Area In Acres
Jackson-Bienville	1955	10-1	10	15	1758	3517	2.0	
	1957	10-18	10	14	1920	3833	1.9	
	1958	10-8	8	14	869	830	.96	
	1959	10-17	6	14	1520	2141	1.74	
	1960	10-1	8	9	1195	2826	2.36	
TOTAL					7262	13151		22,000
Red Dirt	1955	10-1	10	15	225	252	1.1	36,000
Sabine #1	1955	10-1	10	15	454	535	1.2	
	1957	10-18	10	14*	112	151	1.4	
TOTAL					566	686		10,000
Sabine #2	1957	10-18	10	14*	77	116	1.5	12,000
Thistlethwaite	1958	10-4	8	14*	2860	5589	1.95	
	1959	10-17	6	14*	2125	5195	2.45	
	1960	10-1	8	16*	2099	5776	2.75	
	1961	10-7	8	16*	1819	4376	2.40	
	1962	10-6	8	16*	1978	5629	2.85	
second season		12-14	8	3*	265	303	1.14	
	1963	10-5	8	16*	1338	2141	1.00	
second season		11-9	8	9*	236	266	1.13	
	1964	10-3	8	16*	1826	3856	2.1	
second season		11-7	8	9*	342	563	1.6	
	1965	10-2	8	16*	1462	2898	1.98	
second season		11-6	8	9*	461	866	1.88	
	1966	10-1	8	16*	1168	1315	1.13	
second season		11-5	8	9*	257	343	1.33	
	1967	10-7	8	16*	2287	4371	1.91	
second season		11-4	8	9*	434	620	1.42	
TOTAL					20,957	44,108		10,000
Caldwell	1957	10-18	10	14	182	203	1.1	
	1959	10-17	6	7	169	420	2.48	
	1960	10-5	8	9*	216	504	2.33	
TOTAL					567	1127		10,000
Chicago Mills	1959	10-7	6	7	245	715	2.91	
	1960	10-1	8	9*	1087	1902	1.80	100,000
TOTAL					1332	2617		
GRAND TOTAL					57663	11554	2.03	

*Half day hunting only.
All areas hunted by permit only.

RABBITS IN LOUISIANA

By

Jack O. Collins

Introduction

Rabbits are one of the most popular small game mammals in Louisiana, as well as throughout the North American continent. There are about thirty different species and subspecies of the genus (Sylvilagus) in the United States but, only two species occur in this State. One is the field rabbit or cottontail (Sylvilagus floridanus) which weighs about two pounds when fully grown and the other is most commonly referred to as the swamp rabbit (Sylvilagus aquaticus). It reaches an average size of about four pounds at maturity. Other common names of the swamp rabbit are "wood rabbit", "marsh rabbit" and "canecutter".

The number and kind of rabbits inhabiting an area depend primarily on the type of habitat present. Most hunters recognize the fact that cottontails and swamp rabbits generally inhabit entirely different ranges. Where the ranges join, both species may be found.

Life History

Unless otherwise specified the life history material included refers to both species of rabbits.

Sex ratios are about even. This information is based on numerous hunter gab check data and trapping studies conducted in Louisiana.

Rabbits are endowed with the greatest biotic potential of any game species in Louisiana--bird or mammal. Both species of rabbits in Louisiana have a long breeding season. Although some breeding occurs every month of the year, the most heavy reproductive period is during the months from February through September. On some years, depending primarily on warm weather, heavy breeding often starts by late December. Mating is promiscuous among rabbits; however, dominant ones of both sexes frequently chase others from their established territory which may vary from only a few feet radius to a distance of three to four hundred feet.

For nesting purposes, a small semi-circular excavation is dug in the ground to a depth of from four to eight inches and it is usually only a few inches wide. This hole which is dug from one to two weeks prior to birth of the young is lined with grass and fur from the mother's body. While in use it is kept covered with leaves, twigs and grass in order to make it as inconspicuous as possible.

In Louisiana, the gestation period is normally thirty days. This term is used to express the number of days it requires for a rabbit to be born after conception takes place. Breeding may again take place immediately after parturition. Thus, a female can bear a litter of young every thirty days. Litter size averages between three and four. Since one adult female can bear several litters during a single breeding season it is apparent that rabbits have a high breeding potential and can replenish their supply at a rapid rate where optimum habitat conditions exist.

The young, which are born blind and without hair or fur, remain in the nest for about two weeks. During this period the mother rabbit remains in the vicinity and approaches the nest only to suckle the young. Usually there are two feeding periods, one at dusk and one at dawn. At other times the young have no real protection except the nest that serves as concealment. However, the mother will protect her young if danger approaches by whatever means she can. Often she relocates her nest if time permits. The stress call or danger signal of rabbits is a series of intense high-pitched squeals. Mother rabbits hastily appear, particularly, at night when the danger signal is heard. In cold weather the mother will increase the warmth of the nest by plucking more fur from her body and placing it in the nest. The period of lactation is about fifteen days. As the young rabbits grow and get stronger, they leave the nest for short trips for several days before they leave the nest permanently.

Range and Movements

Extensive trapping studies in Louisiana over a period of several years were conducted by the Louisiana Wild Life and Fisheries Commission. By using a system of live trapping, ear tagging for permanent identification and retrapping, information on the distances that rabbits move was obtained. In some experiments bait was used; in others no bait was used. Of several type baits that were used, a variety of "delicious" apples were the most successful.

A simple box type trap 24 inches long by 10 inches high and 10 inches wide was used in all studies from 1956 to 1964. Bait was used to lure the rabbits into the traps. In addition to rabbits many other kinds of animals are trapped when bait is used. Opossums, many kinds of rats and mice, birds, raccoons, squirrels, armadillas, and skunks are the ones most often trapped.

In 1964 the trapping technique was altered and new methods were used. Traps 36 inches by 9 inches by 10 inches were constructed with 1 inch by 2 inches fourteen gauge weld wire. Drift fences or wing extensions were used in the place of bait. These fences were made of 2 to 3 feet high twenty gauge poultry wire that had a mesh size of 1 or 2 inches. When this method was employed the traps were placed at sites where rabbits frequently moved. Drift fences vary in length from a few feet to several hundred feet. Traps were placed parallel to the fence and when a rabbit hopped along the fence seeking a hole it would go into the trap. In other instances holes are cut in the fences at strategic points and a trap is set at these openings.

Rabbits are nocturnal in their habits. Some movements, however, occur during daylight hours in the spring and summer, but this is limited to a short while before dark and after daybreak.

Movements of rabbits may be classified into four categories.

1. Dispersal---This occurs when the young leave the nesting site permanently. Probably this is less than three hundred feet in most cases.

2. Mating---Much activity takes place during this period, but it is not known how far a rabbit moves during this period. However, rabbits never remain over extended periods of time from their established home range.

3. Seasonal---In this state where ecological changes are not apparent within the range of any given rabbit, little seasonal movement results; whereas, in some northern states authorities contend that as a result of seasonal changes rabbits may occasionally move as much as a mile.

4. Daily---Each rabbit establishes a home range in the best available food and cover condition. If left undisturbed a rabbit usually remains in this territory throughout his life. Trapping studies show that the cruising radius of rabbits in Louisiana is between two hundred and six hundred feet. The average is about 400 feet. Although the difference is not known

it is probable that the cruising radius of a swamp rabbit is farther than that of a cottontail.

Food

Natural foods of the rabbit consist of plant materials only. Rabbits consume many kinds of tender, succulent growth of grasses and herbaceous plants, plus buds, berries, seeds, fruits, nuts and current growth of bark and wood from many species of plants. In the management of rabbits for hunting purposes, available foods are not normally a limiting factor in Louisiana. On the other hand, cottontails, in particular, become a serious problem to gardeners and nurserymen. When rabbits begin to eat vegetable crops they will destroy much of the potential table foods if not eradicated or fenced out of the garden. Cottontails frequently damage flower gardens in addition to, on occasion, causing financial loss to growers of horticultural plants and tree seedlings. When a terminal bud is eaten the plant usually becomes worthless to the commercial grower. The above is not a problem of any consequence, but it was mentioned since this is just about the only time when eradication of rabbits is desired. This is mentioned because often the other two major game mammals in this state often become a nuisance and cause financial loss. Examples are: deer versus farm crops and squirrels versus pecan trees and other plants within many incorporated towns of the state.

Cover or Habitat

There is hardly an area in Louisiana in which natural rabbit food is not available, but a big problem in many places is inadequate cover. Several types of cover are needed for rabbits. These are (1) nesting cover (2) resting cover and (3) escape cover.

Rabbits thrive best where considerable "edge" growth exists. Examples of cottontail preferences are brier patches, palmetto thickets, dense undercover, brushpiles, tall grasses and weeds and unmowed fencerows, ditchbanks and railroad right-of-ways.

Where would you go to hunt cottontails? The next question might be "Why is there a shortage in some areas where there used to be an abundance of cottontails?" A closer look may reveal some of the answers.

Rabbits will not be found if cover or a place to hide or rest is absent even if the food supply is adequate. The big problem is food and cover, both of which the rabbit must have for his livelihood.

Cottontail densities have been affected by advances in farming methods and pasture techniques, but they are still found practically everywhere except in the deep woods of big forested areas. Even there occasional cottontails are found especially on abandoned farm sites that have grown up in dense thickets or second growth thickets. On the other hand the fact that they are present is not necessarily indicative of sufficient numbers for good hunting. Probably the two most detrimental effects on the cottontails' range are mechanized farming that leaves little or no cover in the field and improved pasture methods that usually provide much food but no cover in which to hide.

Some dense ground cover is an absolute necessity for swamp rabbits. In the bottomland regions, palmettos and blackberry thickets intermingled with brush and weeds provide ideal habitat conditions. Any openings adjacent to good cover will be heavily utilized. The entanglement of thickets normally found on ridges adjacent to overflow areas or "flats" is a classic example of this type.

Swamp rabbits inhabit all the large wooded areas plus most smaller wood patches in Louisiana. They are more numerous in the vast bottomland hardwood regions and along the many streams that flow through the state. This species is also abundant in the extensive marshlands and cane belt regions. The common names, "swamper", "canecutter", and "marsh rabbit", are very appropriate because this rabbit seems to do as well, if not best, on low lying areas that remain wet almost year-round. Even in overflow areas swamp rabbit densities may be high when good hiding places are available. Louisiana marshes provide an excellent illustration of this fact.

Habitat destruction has been a serious problem in Louisiana since about the time World War II ended. It was during this era when farmers began converting to mechanized equipment from the more antiquated use of horses and mules. Not only the use of mechanical equipment, but also advanced farming techniques have been instrumental in clear land farming and improved pastures that leave little or no cover which is so essential in a rabbit's struggle to survive and maintain a sizeable population. From the standpoint of cottontail habitat and bobwhite quail, also, hedgerows, along fences and ditchbanks, weed patches, brushpiles and other forms of dense ground cover are essential on the farm.

In more recent years the term "bulldozers and soybeans" has been associated with so-called progress in Louisiana. In 1968, over one million acres were planted to soybeans. Although a few acres were planted to soybeans this was a relative unknown crop prior to a decade ago. In all of the rich bottomland regions of Louisiana literally thousands of acres of hardwood timber land are being cleared every week. Undoubtedly, this will continue as long as the demand for soybeans is great. Even with all the increased production the demand is greater than the supply. As a consequence, many bean farmers continue to increase their yearly acreage for the production of this crop. Although bad from the wildlife standpoint, especially swamp rabbits, deer and squirrels, bulldozers and soybeans are going to be with us for a long time to come. As a result of this, habitat for swampers is decreasing at a tremendous pace.

Management-Habitat Improvement

Cottontails

Various degrees of different types of management would increase cottontail rabbit populations on a given area. Two types of management fit most situations. One is less intensive than the other. Along the lines of less intensive management some suggestions are: (1) refrain from clearing or burning fence rows (2) avoid overgrazing (3) fence odd areas and (4) create and leave brushpiles scattered throughout an area. Where more intensive management might be desired as in the case of field trial grounds used by the beagle clubs, seedbeds in the form of strips or plots could be planted to afford the cottontail food and nesting cover. If plots were used the size could vary depending on specific conditions on a particular area, but in most cases it should not be less than one-eighth or more than one acre in size. However, strips are recommended and should be of a convenient width usually between four and thirty feet. Strips should extend the entire length of the managed area. Between each planted strip one of like size should be left fallow. In these fallow strips good permanent type cover in the form of weeds, briers and dense thickets will develop quickly. Recommended winter food plantings would be white clover, crimson clover, rye grass, and tender annuals, if desired. Tender grasses, weeds and legumes are top quality summer foods, too.

Swamp Rabbits

In the case of cottontails use of mechanized equipment has proved harmful. However, the increasing use of mechanical equipment in timber harvest operations is beneficial to swamp rabbit management. Any type of timber harvest other than clearcutting improves the range. Logging almost immediately furnishes excellent cover in the form of treetops and brushheaps. Logging also makes openings. The sprout development that results serves as an important food source to the swamp rabbit. Blackberry thickets along with many other plants grow rapidly in these openings and serve both as providers of food and cover. Undoubtedly, many hunters have observed the fast buildup of a rabbit population within one to two years after extensive logging operations.

The vast pipeline systems that extend through the swamps of Louisiana afford excellent rabbit hunting. Almost immediately after a pipeline is constructed rabbit populations increase along the edges of the woods next to the right-of-way. What causes this? Basically, there are two reasons: (1) the tremendous quantities of young succulent vegetation that grows in the opening and (2) fine hiding and nesting grounds created along the sides through piling up of logs, trees, brush and stumps. As a result the reproductive rates and successful rearing of young are high.

New Management Studies Underway -- Swamp Rabbits

Because of the importance of swamp rabbit hunting and the need for more management information the Fish and Game Division of the Louisiana Wild Life and Fisheries Commission initiated a long range habitat study in Saline Wildlife Management Area in east central Louisiana.

Foresters, lumber companies, large and small landowners, sportsmen, and other interested groups from over the state frequently ask questions such as "What can we do in our forest management practices to improve the wildlife habitat?" From this study some of the answers will be provided about swamp rabbits, in particular.

This experimental work on the Saline Area in designed to determine effects of different degrees of timber thinning on a swamp rabbit population. In addition, game biologists will study plant changes or the ecology that is brought about due to varying logging intensities.

Methods and design of the research are as follows: The area was surveyed and divided into twelve two acre plots. Timber and plant composition of each plot was determined by what professional foresters refer to as a basal area survey. All plants 1 inch in diameter and above were measured and this information was recorded by species and size. A basal area of each plot was determined in this manner. On four of the twelve plots, half the timber was cut and removed; on four plots one-fourth was cut and the remaining four were left in the normal condition to be used as controls. Random selection of plots for different treatments or degree of thinning was employed to avoid as much bias as possible. After logging was completed a five foot high rabbit proof fence was constructed around each plot. Within each plot two pairs of swamp rabbits were placed. Rabbits will be counted at specified intervals of time in order to determine effects of timber thinning on a rabbit population. Valuable information from this study will be obtained within from three to five years. By having extensive knowledge about the trees, small plants, and the rabbit, wildlife technicians can determine what tree densities are best suited for the growth of high rabbit populations, especially in bottomland hardwood regions of Louisiana.

Mortality

The mortality rate in rabbit populations is very high. Most rabbits that are born never reach the age of one year, and of those that reach maturity only a small percent survive to an age of three or four years. Trapping records indicate one adult swamp rabbit was retrapped two years after it was first marked. Neither maximum life span nor average length of life is known. Mammals and birds that prey upon rabbits are almost legion in number. According to published accounts of predation observed by trained wildlife technicians and naturalists these predators range in size from mice to mountain lions. In addition to predators, losses due to weather factors, parasites and disease, and hunting efforts by man are other destructive factors that cause a gradual reduction in rabbit numbers from its peak period in mid-summer to its lowest point in the late winter months.

Nesting losses are considerable. In low lying areas where swamp rabbits seem to prefer, heavy rains and frequent flooding, particularly in the springtime when nesting is high, cause many young to drown before they are large enough to leave the nest permanently. Snakes, too, take their toll of young before the juveniles leave the nest. Other important decimating factors are plowing the soil, mowing grass and weeds and burning. Many young cottontails are lost annually due to these causes. Some early born baby rabbits are lost during severe cold weather but this is uncommon in Louisiana. Many other carnivorous animals destroy rabbits in the nest and at other times, too, but snakes, mowing, plowing, burning and drownings were discussed in this paragraph because these factors are not a major cause of death after the rabbit is large enough to leave the nest.

Young rabbits as well as adults may be affected by extreme weather conditions such as ice and flooding. Prolonged periods of weather extremes seldom occur in Louisiana; thus, these are relatively unimportant mortality factors in this state.

Predatory birds and mammals cause severe annual declines in the rabbit densities throughout Louisiana. All carnivorous animals will prey upon rabbits whenever the opportunity avails itself. Common predators are bobcats, foxes, hawks, owls, feral dogs, housecats, raccoons, opossums, mink, rats and mice, wolves and coyotes and several kinds of snakes.

Bobcats primarily prey upon swamp rabbits largely due to the fact that both seem to prefer the same ecological type for a place to live and as a result they often inhabit the same territory. Bobcats apparently range over a large territory and usually when there is a swamper buildup on a given range this predator increases accordingly. The largest important predator species in this state, bobcats will, on occasion, eat cottontails wherever their ranges come together.

Foxes abound everywhere except in the marshes and eat thousands of rabbits annually in Louisiana.

Hawks prey upon many kinds of animals and undoubtedly, rabbits are a preferred food. Many people have observed a hawk swoop low to the ground, snatch a rabbit with his powerful claws and fly away. Most serious ones are sharp-skinned, Coopers, marsh, red-tailed and red-shouldered hawks in this state. Hawk-predation would be most devastating in the marshlands.

Barred owls destroy many rabbits of both species. This bird eats many other kinds of meat, in addition to rabbits' flesh.

Feral dogs are numerous in many parts of Louisiana and destroy several forms of wildlife including rabbits.

Housecats are a severe predator on cottontails, in particular. Not only do they destroy rabbits, but also numerous kinds of birds including bobwhite quail.

Raccoons are known to eat many rabbits, especially young ones. This species would rank near the top of the predator list in the marshes that comprise over four million acres.

Most of the other predators listed eat rabbits to some degree, but are not normally a limiting factor in a rabbit population.

Parasites and disease result in the mortality of many. Tapeworms and hookworms and others too numerous to mention are common parasites that often cause death in the weaker animals. One disease that has occurred but rarely in Louisiana is Tularemia. In some states at one time or the other this disease caused the death of many rabbits. This disease may be contacted by man. Although it causes severe sickness most people recover from this illness.

Another cause of rabbit losses mostly in cottontails is highway traffic. This is a year-round loss but more frequent during peak breeding periods when the rabbits move more.

Hunting losses are astronomical. A total of 2,059,004 rabbits were killed by hunters in Louisiana during the 1967-68 season. This information was based on a survey conducted by the Louisiana Wild Life and Fisheries Commission. In this period 111,930 hunters reported that 1,254,714 days were spent rabbit hunting.

In summary, both cottontails and swamp rabbits are common throughout Louisiana. Habitat requirements are different for each species. Many factors influence rabbit populations, but the two most important are food and cover availability. Generally food supplies are the lesser of the two problems. In management, certain manipulations will improve the range for rabbits.

THE BLACK BEAR

Louisiana has only one type of bear native to its forests. This animal is known scientifically as Euarctos luteolus. Although referred to as the black bear, the coloration of these animals may range from the more common black color to almost white. The Louisiana bear is typically black, however, as are his other relatives in the Eastern United States. They are the smallest of the bears in North America, weighing from 200 to 300 pounds and occasionally up to 400 pounds. The black bear will generally measure 2 to 3 feet high at the shoulders and may on occasion reach 5 to 6 feet in length, including head and body. The size, as well as many other aspects of this generally misunderstood creature, is about the same as that of the ferral or "wild" hog familiar to almost everyone in our state.

History

Originally the black bear could be found throughout the wooded sections of North America. However, the white man, with the far reaching effects of his growing population and general spoiling encroachment, has restricted its range to the large forested areas which due to rough terrain and associated poor soils have not been subjected to clearing for agriculture or other drastically altering land uses. This is particularly true of Louisiana with its rather high human population. Here and elsewhere bears are present only in those states and localities within, which have sufficiently rough terrain or large wooded areas to allow them to secure a living without unduly interfering with mans' interest.

Bears are rather scarce in our state in comparison with deer and other game animals and have become progressively so since approximately 1920, according to available records. An 1890 statewide survey of parishes containing bears showed 17 parishes, all within the Mississippi-Atchafalaya region, to be inhabited by these animals. This range appears to be greatly reduced from the primary original black bear range within our state, which is believed to have been the denser bottomland areas of the Mississippi, Atchafalaya, Tensas, Red, Ouachita and other major rivers; and no doubt to some extent, the lesser bottomland areas within the drainage basins of each. It seems that bear in Louisiana have always been primarily bottomland hardwood dwellers requiring dense, remote canebreaks to reach peak populations.

The encroachment of civilization, as previously outlined, had by the next 55 years, forced the retreat of black bears within our state to isolated regions that offered the best remaining habitat. These regions, barring a few scattered localities which supported a bear or two, were generally confined to the Madison, Tensas, East Carroll and West Carroll Parish area of the Mississippi delta, and to the lower Atchafalaya River section of St. Mary and possibly adjacent parishes. Here, they seemed to have barely held their own for a decade or so. During this period seasons were opened and closed for bear hunting, without much justification, and few were legally killed.

The advent of modern drainage accompanied by profitable production of agricultural crops, particularly soybeans, has since brought about the wholesale conversion of millions of acres of prime bear and deer habitat into farm land. For this reason the last ditch stand of black bear in the northern region has faded to a few individuals on remaining larger wooded areas, the majority of which are batture lands, unsuitable for agriculture, immediately adjacent to the Mississippi River. Native populations were forced to relocate in nearby Mississippi and Arkansas woodlands. Many were lost to illegal hunting, highway accidents, and other causes. Under present trends of land clearing for agriculture in this highly productive delta area, black bear populations are inevitably doomed. The extent of habitat destruction in the lower Atchafalaya region has not been as great but many adverse factors exist in this area. Future plans for channelization of the Atchafalaya River with accompanying alterations of habitat conditions, as well as increased encroachment on the wilderness aspect of the area, may spell a similar doom for the remnant population of black bear holding out there.

An understanding of the present status of the black bear in Louisiana must of necessity deal largely with the history of its occurrence, as the role of the black bear as an important and prospering game animal in our state is indeed a matter of history. With this objective demonstrated in the proceeding, we will consider the general biology and management of black bear from this point on.

Reproduction

Black bears breed at approximately 3 1/2 years old and the gestation period is approximately 210 days, or about 7 months; therefore, the female bear, known as the sow, will give birth to her first litter of cubs at about four years of age. She then breeds only every second year. Her cubs remain with her until this time. Cubs are small at birth, weighing less than a pound, so during pregnancy there is little drain on the mother's vitality. The young are born during hibernation in northern states but in the south hibernation apparently does not occur. Mating takes place about July and cubs are born around January.

After mating season the male bear, known as the boar, goes his separate way and has nothing to do with his following offspring. The entire association of adult boar bears with the family or the female is limited to reproduction.

The number of cubs in a litter may vary from one to five, with two being the most common. Since females breed every second year, it can readily be seen that bears average only one cub a year. Taking into consideration the slow reproductive capacity and destruction of habitat, the bear seems to be a master in avoiding man to even maintain his population.

Hollow logs, caves, dense thickets and hollow trees are favorite sites for a bear's home, commonly known as his den. Among the favorite dens for bears in Louisiana are the giant hollow cypress trees scattered along the bayous and through the woodlands of good bear country. A den may be close to the ground or 60 feet above, as black bears are expert climbers.

Movements

Bears, by nature, are very wide rangers, covering areas often in excess of ten miles in diameter in search of food or merely roaming over territory that they consider to be their own. Game managers refer to this territory as the home range of the animal. Prominent trails, tracks, wallows, logs and stumps torn up in search of grubs and insects and clawed marks on trees are well recognized signs of bear inhabiting an area. Reportedly, boars, in marking their home range, have a tendency to stand on their fore feet.

Diminishing habitat coupled with a very wide home range brings the black bear into contact with man much too often for its own good.

Food Habits

Black bears are omnivorous which means they will eat practically any type of food, plant or animal. Their food habits are almost identical to that of a pig. This includes berries and other fruits, seeds, insects, grubs, roots, nuts, fish, and a variety of other things including low forms of animal life. Farmers can testify as to a bear's liking for roasting ear corn, and of course honey is one of its favorites. Bears like water and consequently do not live far from it. They drink freely and like cool muddy places to wallow, perhaps to escape insects or merely to indulge in what is considered a luxury.

Management and General Information

Little is known concerning wildlife management practices for black bears. Rigid protection, especially for the cubs and bag limits of one bear per season, are characteristic measures taken by most bear hunting states. The closing of hunting seasons and restocking are often initiated where numbers of black bear are dangerously low. Both of these measures have been taken in Louisiana. Approximately eighty black bear were live trapped from Minnesota and brought into our state for the purpose of restocking our suitable woodlands with these valuable game animals. The success of the project is largely unknown at the present. Nearly half of the animals fell victim to illegal hunting, highway accidents, and other mortality factors, during their initial period of wandering in search of a suitable home range. The majority of these bear releases were made in the lower Atchafalaya region with others being released in the Tensas and

Madison Parish area on the Chicago Mill Wildlife Management Area. The loss of the Chicago Mill and The East Carroll Wildlife Management Areas to agriculture and private interests no doubt started a decisive trend toward gradual extinction of black bear in north Louisiana, since these two tracts of timberland supported a large part of the remaining bear population. Only a reversal of the agricultural trends previously discussed could forestall this happening. The vast Atchafalaya area may offer the last hope for bear country in our state.

On the other hand, millions of acres of game habitat in the hill areas of Louisiana are developing rapidly into an isolated semi-wilderness condition.

If the black bear could find this area to his liking, he would be back in business again. Just how common bear previously were in these areas is not known. Indications are that at least they did occur there, even though large bottomland areas seemed to be preferred and are the areas of last retreat. Vast acreages of bottomland areas are owned by timber companies in west, northwest, and northeast Louisiana. Rapid urbanization and clearing for cultivation has emphasized the necessity of isolating the bottomland areas of creeks and small rivers, that might provide a suitable habitat.

The recent purchase of bottomland hardwood tracts for wildlife management purposes may offer limited possibilities for bear, especially if more and larger tracts relatively free from annual flooding are obtained.

The maintenance of very large blocks of isolated forest, containing dense understory, has been and will continue to be the soundest management practice available for bear. The area must be large enough to enable bears to go about their normal activities with little or no contact with man. Annual floods and other occurrences must not force them onto lands where interference with man and his interests will result.

Unfortunately, the word "bear" strikes an inherited fear in the hearts of most people, and these relatively timid and docile creatures are automatically regarded as dangerous vermin that should be exterminated.

It is true that they are powerful animals capable of vicious fighting when made to do so. For that matter, however, so are our domestic pig and cow, each of which is a very powerful animal that is dangerous under certain circumstances. Many authorities have declared that the common ferral or "wild" hog is far more dangerous than our native bear.

The future of bear in our state will depend almost solely upon two factors which are: Agricultural and forestry trends that will determine the availability of suitable habitat, and the interest and tolerance shown by man toward restoring populations of these animals.

(This section was written by Jerry Ferrar and Dan Dennett.)

WHITE-TAILED DEER

The white-tailed deer is Louisiana's only big game mammal and our sole representative of a distinguished family of animals that includes the elk, moose, caribou, and mule deer. From the scientific standpoint, however, our state does have two subspecies or races of the white-tailed deer. The more common type inhabiting the pine forests, as well as the bottomland hardwood areas, is actually the Kansas White-tail which carries the scientific name of Odocoileus virginianus macoura. A slightly different deer is found native to the coastal swamps and marshes of our state, which is known as Odocoileus virginanus Mcilhennyi. This animal is known as the Avery Island White-tail. It is not our most common deer and occurs naturally only in the described coastal areas. Where the natural ranges of these two races join, mixing and interbreeding frequently occurs.

History

The cutting of solid stand virgin forests, as well as following trends in forest use, has created a haven of food and cover for white-tailed deer in the Southeastern United States. Since the late forties deer populations in this region have steadily climbed. This has been brought about primarily by the deer restocking program initiated in most of the southeastern states. Game and fish agencies aided by funds made available by the Pittman-Robertson Act and technical assistance of trained wildlife biologists, have gradually brought the white-tailed deer to the high levels of population that it is today. Louisiana was one of the first southeastern states to launch into this program and is justifiably proud of its highly successful deer restocking efforts. Flourishing deer herds are now found throughout the state and at least nucleus populations are found in every parish of the state. Although early efforts in the deer restocking program did involve the release of a few deer imported from Wisconsin, the vast majority of deer used for restocking were native Louisiana deer. Often, when an unusually large deer is taken by hunters, local "experts" are quick to state that the deer is probably "one of those big Wisconsin deer they turned loose." This is a completely wrong assumption since weight records indicate that our own native white-tailed deer are equally as large. Native white-tails have been recorded as weighing in excess of three hundred pounds, which is certainly comparable to deer from any section of the nation.

In 1952 information gathered by biologists of the Louisiana Wild Life and Fisheries Commission showed that major concentrations of deer were to be found only in the bottomland hardwood regions of the Mississippi and the Atchafalaya River flood plains, scattered through the coastal marshes and in several localities in the pine lands within the Kisatchie National Forest in Central Louisiana.

Since that time deer have been released in almost every parish in Louisiana and have helped to establish huntable populations in most sections of the state. By 1966 practically all suitable deer habitat was occupied by the white-tailed deer. Hunting regulations for recent deer seasons provided hunters with the most wide-spread hunting opportunity ever offered.

Now that deer herds are well established it is necessary that these deer herds be managed with sound judgment that is founded on the best technical knowledge available to us, if we are to maintain this high level of success. It should be clearly stated that the management of deer herds is a science that should be left to trained professionals in order that this valuable natural resource can be used so as to provide maximum opportunity to the citizens of Louisiana.

Reproduction

The mating season for Louisiana deer occurs from mid-October to at least mid-January, depending upon the area. There is a difference between the time of the peak mating period in the northwestern part of the state as compared to the Mississippi River Delta area. One buck deer on natural range will usually breed with four or more does in a single season. In captivity, a single buck has been known to successfully mate with 19 does in one breeding season. On good deer range, about one-half of the doe fawns will mate successfully and produce fawns when they are one year old. In Iowa it has been found that about 75 percent of the doe fawns breed at six months of age. On poor range it is very unusual for any six month old fawns to breed. The gestation, or pregnancy, period for deer is about 210 days, with fawns being born in Louisiana from mid-May to mid-August. Six month old does and other first-bred does usually produce a single fawn. Other does usually produce twins, depending upon how well they are nourished, and occasionally triplets are born. Deer are most productive between 4-6 years of age, and it is probable that most triplets are born to does in this age category. Fawns generally are weaned and lose their spots at a little more than four months of age.

Buck deer grow a new set of antlers each summer, shedding the old ones, in Louisiana, any time from December to March. The shed antlers are eaten by rats, mice, squirrels and rabbits to satisfy their calcium and phosphorus requirements. As a rule, does do not grow antlers, however, it does happen and some of these animals have been known to breed and successfully rear fawns. Usually, the so-called "antlered doe" is capable of reproduction, but does which have been injected with a male hormone have grown antlers and still reproduced normally.

Growth of a buck's antlers depend more on his ability to obtain adequate amounts of quality food than it does on his age. It is true that, when well fed, older animals (4-7 years of age) usually produce the largest racks of antlers. However, 1 1/2 year old bucks on good winter range will grow racks having from 4-8 points. Quality of winter range determines the size of antler growth. On poor winter range, it may take a buck 2 1/2 years or longer to grow 3 inch spikes. So, you can see that in areas of poor range, under a "buck's only hunting law" a deer may have to feed an extra year or more in order to be a legal target. While on good range during this same period of time two deer could have been produced.

Movements

The white-tailed deer is basically a sedentary animal, as they live their entire lives in a relatively small area unless repeatedly disturbed. The home range of a deer under normal conditions has been variously described as being not more than one-half to one mile in radius, but there are certain types of influences that will cause them to move greater distances. For instance, a buck deer will move much greater distances during the breeding season; during winter months all deer will occasionally move much greater distances in search of favored food such as acorns or soybeans. When chased by dogs, deer will also move much greater distances than are encompassed in their home range. Deer movements can be summed up very briefly as follows: as a result of several forces deer will move great distances from their home range, but barring death or accident they usually return to the same area where they were born and have spent most of their lives. There are many recorded instances in which large numbers of deer have starved to death on their home ranges when plenty of food was available short distances away and there were no natural barriers to keep them from reaching it.

Food Habits

The feeding habits of deer differ from cattle in that deer are primarily browsers, not grazers. Their main foods are vines, weeds, twigs, and seeds or the fruits of trees and shrubs. Grasses are taken only when the preferred foods are not available in sufficient quantities. This is commonly seen in overpopulated areas where they can be observed eating wheat, rye, oats and other grasses found in pasturelands. Deer require relatively large quantities of browse material. As a matter of fact, for each 100 pounds of body weight deer require about 5-7 pounds of green browse daily, which is just about a bushel basket full. Just a little figuring will show you that a 100 pound deer will normally eat from 1,825 to 2,555 pounds of browse each year.

Acorns and many kinds of fruits and berries, commonly known as mast, are excellent deer foods when they are available. The quality of a deer range cannot be determined by the amount of mast, for in the first place, annual mast crops are highly unreliable. Mast production is subject to the vagaries of weather and on an average a good crop can be expected about every 3 years and a bumper crop about every 5-7 years. Secondly, when there is a good mast crop, it lasts for no more than three months, and deer must eat for the entire 12 months each year. When mast crops are available, the following year's fawn crop will probably be better, and antler growth will also be better the next year; this is especially true on over-crowded deer ranges. In Louisiana this is a complicating factor when attempting to evaluate deer ranges by the physical condition of deer.

From this point on we shall delve into some of the technical aspects of deer management and attempt to acquaint the reader with the many considerations that must be made in managing deer herds wisely.

It would be best to begin a discussion of deer management by noting that Louisiana has a variety of soil types. The chemical composition of these soil types is highly variable. Different soil types are characterized by the presence of certain particular species of plants. Due to the tolerance of the individual plant species to the chemical elements found in these different soils, the distribution of plant species is closely related to changes in soil composition. It is thus understandable why each vegetative type has a different deer producing potential.

Since deer depend entirely on plants or plant seeds for their livelihood, we can easily see that the ability of a given area to produce deer is governed primarily by the quality and quantity of natural foods available to the deer. We must understand that any given area of deer habitat is capable of producing only a certain number of deer, even under the most ideal conditions. This number of deer is also dependent upon other different factors, such as the management history and age of the deer herd. The amount of hunting pressure, both legal and illegal, should also be considered. The influence of free-ranging dogs, year round use of dogs in hunting, and competition by livestock is of extreme importance. Diseases and parasites have the capability of causing serious reductions in the size of a deer herd and should not be overlooked.

The ability of deer to reproduce is quite often underestimated. If we were to assume an ideal situation where no limiting factors existed and there could be reproduction at an average rate, then 20 bucks and 20 does given 5 years of propagation would rise to a herd of 647 deer. In arriving at this figure, we must make the assumption that does, on the average, bring forth 1.5 fawns annually and that no deaths occur within the 5 year period. This is merely a hypothetical situation which serves to illustrate the high reproductive potential possessed by the white-tailed deer.

After the potential reproductive capability of the white-tailed deer is demonstrated, the development of a deer herd can be more clearly understood. In a normal situation the natural checks and balances existing within the habitat come into play to regulate and influence the progress of herd development. While the population still increases at a terrific rate, it does not compare with the reproduction rate possible in a hypothetical herd having no limiting influences. We can naturally expect some mortality either from disease, highway accidents, illegal kills, predators, or numerous minor causes. The ravages of mother nature in the form of floods, droughts, hurricanes and forest fires also take their tolls. These drastic and sensational forms of herd reduction usually have a minor role in curtailing the development of a new deer population. The primary limiting factor of the developing deer herd is the availability of quality preferred foods. As the new deer population rises, there is an increase in their use of the natural range. Because the habitat at any given time can only supply a certain quantity of natural preferred quality foods without seriously damaging the production potential of that range, there is a limit to the number of deer that can be safely carried on the range without detriment to the deer and the range. This limit in the population is said to be the carrying capacity of the range. Any animals produced past this point will result in increasing damage to the deer herd and the range.

With the lowering of both the quality and quantity of the natural available food, there is brought about a decline in the general condition of the deer within the herd. This is indicated by a reduction in general body size, a lowered capacity for reproduction, and an increase in the susceptibility to parasites and disease. The total effect of these factors is a steady decline in the deer population until the herd has reached a level below the natural carrying capacity of the range. At this time, the range begins to recover because of the decrease in utilization placed upon it and the deer herd once again responds to the increasing food supply. Again the herd will reach a population level above the natural capacity of the range if allowed to go unchecked. However, this time the herd will naturally peak at a level below that of the original population peak. Because of the damage inflicted upon the vegetation by the deer during the first period of overpopulation, the ability of the plants to produce browse has been somewhat curtailed and the amount of food produced by these browse plants is lower than that produced during the initial growth of the population. Each successive peak will be lower than the original population peak because of the lower rate of recovery of the range after each period of abuse.

This knowledge of the mechanics of deer population fluctuation is the basis for scientific deer management. It should be the goal of any deer management program to keep all deer herds within the natural carrying capacity of their range. By so doing, the range suffers no damage and maintains its ability to produce an optimum amount of food which in turn keeps the resident deer herd in excellent general condition with a high productive capability.

Most established and managed deer herds on a well balanced range will reproduce, and increase in number, by approximately 30 percent each year. After the herd has reached carrying capacity, then it is necessary to annually remove approximately 30 percent of the herd in order to prevent an increase in population to a point above the natural limits of the range. In spite of the fact that the white-tailed deer has been subjected to some of the most intensive scientific study of any wild animal on the North American Continent, we still know of only one way that deer herds can be effectively and realistically controlled. This, of course, is by using the hunter's gun during an either-sex deer season. Bucks - only seasons which have been common in the past will harvest only a fraction of the animals that should be removed from the range; whereas, carefully regulated either-sex seasons not only provide sportsmen with added recreational opportunity, they also regulate the deer herds and prevent range deterioration and decline in general condition of the deer, or ultimate self destruction of the deer herd. Deer herds managed in this manner can provide a sustained annual yield of deer for the hunter.

Over a sustained period of time herds managed in this manner will produce far more deer than herds regulated by bucks-only seasons. While this concept of deer management is often bitterly opposed, it has the best interest of the sportsman, the deer herd, and the habitat in mind. With management such as this, good protection and the cooperation of Louisiana sportsmen, our annual deer harvest would be nearly three times what it is today.

Biologists are continually trying to improve deer management techniques for the white-tailed deer by investigating all aspects of the habitat and life history of this valuable game animal. This type of information will increase our management efficiency, which will in turn benefit sportsmen. It should also be mentioned that in gathering data at deer checking stations most biologists with several year's experience have handled more deer than the average deer hunter will see in the woods during the course of a lifetime of deer hunting.

In our attempt to learn more about the basic biology of the white-tailed deer we have turned to game management areas of our state. Here the controlled hunting seasons held annually create an almost ideal situation for gathering management information on the white-tailed deer. The fact that management pays off is clearly illustrated when we consider that on a per acre basis more deer are annually removed from the game management areas than on any other type of hunting area in the state. Game management areas are maintained and operated by the Louisiana Wild Life and Fisheries Commission for the purpose of providing maximum utilization of our wildlife resources by the general public. Some of these areas are owned by the Commission, others are merely leased for this purpose.

(This section was written by Dr. John Bateman .)

THE WILD TURKEY

History

The history of the wild turkey on the North American continent is most interesting. Many of the initial explorations within this continent were conducted by the Spaniards in Mexico and Central America. During these early explorations the Spaniards learned of the eating qualities of the wild turkey from the Aztec Indians of southern Mexico, who had long before mastered the art of domestication. Subsequently the Spaniards acquired breeding stock of this bird and took it back to Europe where it flourished and spread. The pilgrims brought domesticated stocks of this originally wild turkey to the new world with them and found to their amazement tremendous flocks of wild turkeys inhabiting the primeval forests around their settlements. The turkey that the pilgrims brought to this country, the present domesticated turkey with which we are all so familiar, was what is presently known as Merriam's turkey. It is native to Southwestern United States and Mexico and has expanded its range in recent years. The turkey they found on their arrival on the New England coast was the Eastern wild turkey, which many of us have not been privileged to meet too often in the wild state, but yet is the wild turkey which is native to Louisiana. Major differences in these two birds are in coloration and the type of habitat naturally occupied. Even though Merriam's turkey has never been successfully introduced into the wild in the Eastern United States, it and the Eastern wild turkey cannot be separated morphologically.

The wild turkey (Meleagris gallopavo) represents the only member of this unique family of game birds that is found on the North American continent. However, it is represented by six subspecies in North America.

History indicated that turkeys originally occupied 39 of the contiguous 48 states. Presently, they occupy no more than 20 states and 20-30 percent of the original range. However, they have been re-introduced into some areas of original range and certain subspecies have been successfully established in formerly unoccupied ranges. The most notable of the efforts has been the re-introduction of the Eastern wild turkey in New York, and the introduction of Merriam's turkey in South Dakota, Montana, and Wyoming.

In contrast with deer populations, for example, the wild turkey population is from all evidence not increasing.

This brief resume of turkey history in North America is interesting but it doesn't tell us what we need to know about the Eastern wild turkey, which is the only one of the six subspecies of turkeys that occurs naturally in the wild in Louisiana.

Life History

The wild turkey is polygamous; one mature gobbler usually mates with several hens during the breeding season. During the period of egg laying, the gobbler usually mates with all of the hens in his harem each day. This is, no doubt, the reason why turkeys have such an unusually high ratio of egg fertility; it usually averages about 98 percent. It is generally conceded that yearling gobblers (1 year old) do not breed; however, it is common for yearling hens to breed.

The reproductive season normally runs from March to July; this includes mating, egg laying and incubation. In Louisiana the peak of the mating season is in April.

Nesting usually begins about mid-April. A turkey hen lays from 7-16 eggs and averages about 10-11. Incubation requires 28 days. A hen will renest if the first nesting attempt fails. However, on second nesting attempts, there is usually a much lowered fertility of the eggs.

Young turkeys (poults) are precocious which simply means that they leave the nest soon after hatching. They remain in the vicinity of the nest for a few days gaining strength and learning to eat. They grow fast and at about four weeks of age they can take short flights.

Throughout the summer and fall the poults remain with the hen and may be joined by immature males or hens that have been unsuccessful in bringing off a brood.

Food Habits

Turkeys utilize a variety of materials as food. Vegetable material is the most important and always makes up at least 75 percent of their diet. Acorns, beechnuts, pine seed, seeds of many other woody and herbaceous plants, fleshy fruits, green leaves and stems constitute the major vegetable foods eaten by turkeys. Insects are a very important element in the diet of turkeys, especially poults; and during late spring, summer and early fall cultivated grain and cover crops are, at times, extremely important for turkeys.

Movements

There are several types of movements that are a part of the everyday and seasonal lives of turkeys. Daily movements of turkeys in search of food are extensive and may cover several miles.

In the fall of the year several hens with their young may band together to form large flocks and additional immature males and hens may join with them. With the advent of colder weather, the adult gobblers usually form small bands and remain segregated from the hens and poults.

Also in the fall there is a general movement from summer range to winter range and this movement is associated with food supply.

Once these flocks are formed in the fall, the turkeys remain together and on generally the same winter range until about the first of March. In early March the flocks begin to break up and disperse to the nesting areas and subsequently to summer range.

Habitat

Basically the Eastern wild turkey is a bird of the mature forest, and ideal turkey range is characterized by a diversity of tree species and age classes well interspersed with openings and cultivated land. In contrast with deer habitat turkeys do best in areas having a large percentage of mature forests. These mature forests should be largely made up of preferred mast bearing species.

Some good guidelines to keep in mind concerning turkey habitat are:

1. Water is essential to turkeys and should be well distributed throughout their range.
2. Large unbroken stands of timber are not desirable. This is particularly true of evergreens such as pines. There should be well distributed clearings throughout forested areas.
3 Competition between turkeys and hogs, cattle, and deer can be a critical factor in turkey management.

4. Plantings in well distributed plots of oats, wheat, vetch, clover, browntop millet and chufa can be very beneficial.

Management

There is probably less known about turkey management than there is about any other game species. Even though good turkey range has been characterized, there have been many failures to establish turkeys in areas that apparently meet these requirements.

The wild turkey has a very high breeding potential. However, there is some doubt that this potential has or ever will be reached in the wild. Actually, its potential is almost as high as that for quail, doves, etc., but there are reasons why turkey populations never reach the density that quail populations do. The turkey's requirements for living are much higher than those of quail. Consequently, wild turkey populations cannot be expected to go higher than about one bird to 20 or 25 acres, although it has been estimated by some authorities that it is possible to carry one turkey to 15-25 acres on good range in the southeastern United States under intensive management.

There are basically two ways to approach turkey management:

1. Improve populations in areas where remnant populations exist. This can be accomplished by one or a combination of all of the following:
    a. The first and it is believed the most important step is to control all illegal hunting. Probably the most important limiting factor that we have working on turkey populations in Louisiana is illegal hunting. Since the turkey's range requirements are so great, a good poaching job on one flock of turkeys can seriously

affect the turkey population over a relatively large area.

   b. The second thing that can be done is to manipulate certain factors in the habitat to more nearly provide ideal habitat--such things as creating openings, eliminating competition from livestock, planting winter and summer foods, encouraging the growth of mast bearing trees, and the elimination of various disturbance factors.
   c. The third thing that might be done would be to augment the existing stock with a release of wild trapped birds.

2. The second approach to turkey management concerns the introduction of turkeys into areas where no turkeys exist. In this approach the necessity of selecting areas which possess all the qualities of good turkey range cannot be overemphasized. And it might also be well to be prepared to set the table for the birds when they are released--plantings of summer and winter food plots should suffice.

The selection of basic breeding stock should be approached with caution. If the area to be stocked was originally occupied by a particular subspecies of turkey, use that subspecies. At the present time there is no place known where releases of wild-trapped turkey of one subspecies were successful in establishing themselves in an area formerly occupied by a different subspecies. One exception to this, however, may be the recent introduction into Louisiana of a subspecies native to Florida. There are several examples of phenomenally successful releases of turkeys into originally occupied areas as well as into areas outside the ancestral range of any subspecies of wild turkey.

The selection of basic breeding stock should be approached with caution. Only wild-trapped turkeys should ever be used in re-stocking efforts. The records are full of accounts of dismal failures of pen-raised turkey releases. Practically every state east of the Mississippi River has attempted re-stocking with pen-raised birds, and apparently the only accomplishment has been the dilution of existing wild turkey populations. One good reason for the failure is that pen-raised birds available for stocking are not of the pure Eastern wild turkey strain. All of them have been mixed with the domestic turkey in varying degrees. This, coupled with the fact that pen-raised gallinaceous birds have never done well in the wild, spelled failure before the birds were released.

In the south turkey hunting has traditionally been restricted to hunting gobblers during the mating season in the spring. In recent years, however, some of the states have initiated a winter season on all turkeys, in addition to the spring season on gobblers. This move apparently has not hurt the basic breeding stock since many birds were annually removed in the fall illegally by squirrel and deer hunters. This latter liberalization of hunting regulations should not be attempted until the respective range has reached carrying capacity. A statewide turkey management program is necessary if maximum benefits are to be derived from this valuable game bird.

(This section was written by Jerry Ferrar and Dan Dennett.)